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REPORT OF RETIRING PRESIDENT

NEW YORK SOCIETY OF ORTHODONTISTS

FRED RALPH BLUMENTHAL, D.M.D., BOSTON, MASS.

IT HAS been my privilege and honor to serve as your president during the past year. In this capacity it is my happy duty to report to you at this time upon the activities of the society during my term of office and to offer a few comments and suggestions which may possibly be of help to the incoming officers in carrying on the work from this point.

Article II of our Constitution states that "the object of this society shall be the advancement and study of orthodontia." The members of the various committees have made every effort to fulfill this obligation and in planning the meetings have selected essayists and clinicians with this in mind. They have been successful in placing upon our program many leaders of our profession and of allied professions who have presented to you material of the highest caliber and of the highest scientific value. It was the aim of the Executive Committee to place upon the program this year many of the younger men in our profession in order to prepare them for carrying on the future work of our society. I believe we have all been pleased with their splendid contributions which have spoken well for their understanding of our highly specialized branch of dentistry. Their presentations clearly indicate the high professional standards of our present-day postgraduate courses in orthodontics, in which we are all so greatly interested.

I shall not take time to comment upon details of the various contributions at this time as they will be available to the members through publication. To

Meeting held in New York, N. Y., March 23, 1936.

summarize briefly, the subjects upon our program have included essays on anatomy, genesis of malocclusion, early and delayed treatment of malocclusions, influence of third molars on occlusion, symposium on failures of orthodontic treatment, case reports by many operators using various methods of treatment, oral surgery, plastic surgery, cleft palate and harelip (from the operative and the mechanical viewpoints), and clinics showing the latest achievements in mechanical and biological researches. It was refreshing to have so many papers and clinics received with enthusiasm and applauded for their true merit and scientific worth. The discussions were freely entered into, and, although at times marked differences of opinion were manifest, it is through free and intelligent discussion that we benefit the most.

I wish to take this opportunity to thank all the essayists and clinicians who so willingly contributed to the meetings of the past as well as those men who led discussions on the various papers and whose opinions also added to the value of our meetings.

The society as a whole has shown a spirit of enthusiasm and interest resulting in a larger attendance at this year's meetings than ever before. The splendid cooperation of the members of our profession, as well as of those of allied professions, has been most apparent and is deeply appreciated by the retiring officers of the society.

As the success of any society is largely dependent on the functioning of the administrative board, I should like at this time to express my appreciation of the splendid assistance I have received from the board members. I feel very sincerely that to them is due much of the credit for the success of my term of office. Any credit due me lies largely in my selection of the various committee chairmen. Members of the Executive Committee, the Board of Censors, and the Advisory Committee have worked faithfully, conscientiously, and untiringly.

Your selection of Dr. Franklin A. Squires as secretary-treasurer of the organization has been one of my greatest good fortunes, for he has carried out the duties of his office to the fullest degree and has been of invaluable aid to me.

The services of the editor in preparing the articles of the essayists for publication so speedily, so thoroughly, and so carefully demand commendation from the chair at this time.

The counsel given me by the president-elect and the members of special committees has been most valuable and is appreciated.

As retiring president, may I, at this time, call to your attention one or two matters which seem to be of vital interest and importance to us for future action? Our society has recently passed upon a reorganization program which is to be presented before the American Society of Orthodontists at the meeting in St. Louis on April 20. Dr. Leuman Waugh, past president of this organization, who needs no introduction to you, has worked hard and conscientiously for you and for your benefit in this plan. May I urge that as many as possible of our members be present at the next meeting of the American Society of Orthodontists and lend their support toward this reorganization plan and the success of the meeting which promises to be one of the best in the history of the organization?

The second has to do with a question of orthodontic procedure—that of extracting the first permanent molars. I do not personally believe that you are fully acquainted with the extent to which this propaganda is being spread and the serious harm that is being done to the public at large and to the profession itself by it. So many of us have seen the ill effects of this procedure that I am taking the liberty of rereading a resolution which was adopted by this and other national societies because I feel that it is of sufficient importance for us all to give our careful consideration.

EXTRACTION OF FIRST PERMANENT MOLARS AS AN ORTHODONTIC PROCEDURE

Because of the fact that there has been distributed through the public press, and other agencies, misinformation regarding the importance of children's first permanent molars, and inasmuch as such publicity tends to encourage parents to submit to their routine extraction in the belief that by so doing orthodontic procedures may be simplified, be it

Resolved, that the Orthodontic Staff of the Forsyth Dental Infirmary for Children hereby goes on record as protesting against the further dissemination of such archaic advice and furthermore condemns its practice.

Unanimously adopted by the Orthodontic Staff, Forsyth Dental Infirmary for Children and endorsed by

PERCY R. HOWE, Director
ERVIN A. JOHNSON, Trustee
LEROY M. S. MINER, Trustee and Dean,
Harvard University Dental School.

Unanimously adopted by the Orthodontic Staff, Harvard University Dental School.

Unanimously adopted by the American Society of Orthodontists.

Unanimously adopted by the New York Society of Orthodontists.

January 30, 1935.

I must also call your attention to another unpleasant matter, that of fee splitting among members of the profession. I regret to state that within the last few days I have been advised that there has been an apparent renewed activity in this unethical practice. I sincerely hope that no members of this society will stoop to this level. The matter must receive our undivided attention. My term of office will not permit me, in my capacity as president, to take any definite action on these two matters, yet I should like to suggest that my successors in office, for the good of our society and profession, and for the good of the public which we serve, make every effort to exterminate these practices. I do hereby pledge my personal support in any capacity in which I may be of assistance in this matter.

Another matter which I feel we should be considering at this time is that of legislation and certification of orthodontists. This subject is of vital importance to us individually and collectively. A poll has recently been taken throughout the country relative to this subject and, although I cannot give you a detailed report at this time, I can say with certainty that it has been the consensus of opinion that efforts should be made and will be made in this direction. In the interest of our profession, I sincerely hope that, in some way, this matter may be brought to the attention of our society and be thoroughly discussed in the near future.

Before concluding I should like to mention the great loss which the orthodontic profession throughout the world has suffered in the death of our esteemed colleague, Dr. Albert H. Ketcham, the first president of the American Board of

Orthodontia. His extensive research work and his admirable teachings will long be remembered. I would ask that you all rise for a moment of silent tribute to the memory of this great educator.

In conclusion, I wish again to express my high appreciation of the honor conferred upon me in selecting me as your president for the past year and again to thank the officers and the members for their splendid efforts toward the fulfillment of the object of this society in advancing the study and practice of orthodontics. I wish to offer also my personal congratulations and best wishes to the incoming officers for a most successful year.

QUESTION OF THE INFLUENCE OF ERUPTING OR IMPACTED THIRD MOLARS ON THE OCCLUSION OF TREATED AND UNTREATED CASES

RALPH WALDRON, D.D.S., F.A.C.D., NEWARK, N. J.

THE replies received from the twelve practitioners who have so generously contributed toward this symposium express the honest conviction of each and every man, according to the impression made upon him by his own experiences in his daily practice. Unanimity of opinion cannot be expected, for our present knowledge of this subject is very unsatisfactory. Most of our opinions or judgments are based upon clinical observations, and these are not properly organized, nor supported by adequate objective data. To solve problems of this kind requires more than clinical observations which at times are often misinterpreted.

It has been of great interest to me to observe that opinions on this subject like those on present-day politics are many and varied, running the gamut from radicalism to ultraconservatism, and that opinions are subject to change in the light of new evidence and further experience.

With this thought in mind I shall now present the opinions of twelve well-known and experienced orthodontists who are located in widely distributed parts of this country.

GEORGE GRIEVE, TORONTO, CANADA

I believe that practically all orthodontists of experience, as well as many men in general practice, agree that in many patients, whether treated orthodontically or not, erupting third molars are often responsible for disturbance of the occlusion. The unfortunate point is that many orthodontists do not realize that this baneful influence is often exerted also by the second molars and the first molars as well. In other words, malocclusion is usually the result of a forward displacement of the teeth.

In Sim Wallace's *Variations in the Form of the Jaws,* on page 62, he quotes John Hunter's description of the growth of the jaws, as follows: "The jaw still increases in all points till twelve months after birth when the bodies of all the six teeth are pretty well formed, but it never after increases in length between the symphysis and the sixth tooth; and from this time, too, the alveolar process which makes the anterior part of the arches of both jaws never becomes a section of a larger circle, whence the lower part of a child's face is flatter, or not so projecting forward as in the adult.

"After this time the jaws lengthen only their posterior ends, so that the sixth tooth, which was under the coronoid process in the lower jaw and in

Read before the New York Society of Orthodontists, New York City, March 23, 1936.

the tubercle of the upper jaw of the fetus, is at last—viz., in the eighth or ninth year—placed between these parts, and then the seventh tooth appears in the place which the sixth tooth occupied with respect to the coronoid process and tubercle, and about the twelfth or fourteenth year the eighth tooth is situated where the seventh tooth was placed. At the age of 18 or 20 the eighth tooth is found between the coronoid process in the lower jaw and under or somewhat before the tubercle in the upper jaw, which tubercle is no more than a succession of sockets for the teeth till they are completely formed."

Impacted third molars are caused by insufficient backward growth of the jaws to accommodate all the tooth material, and, where there is crowding of the teeth anterior to the molars, it comes about as result of a forward displacement of all the teeth from the effort of the molars to find a place in the dental arches. Waugh has reported that there is no malocclusion among the Eskimos living beyond our civilization. Price has also found the same thing in isolated people in Switzerland and the Hebrides, in both instances people living upon

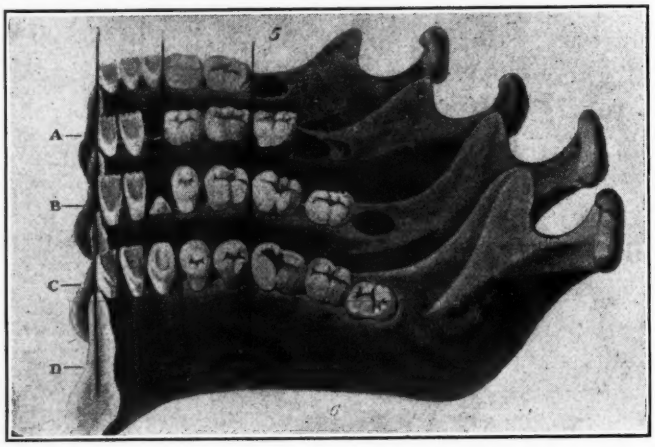


Fig. 1.—Illustrating John Hunter's description of the growth of the mandible, and exemplifying the changes which take place in the teeth at different periods.

A, Part of the mandible of a child at six years, when only the deciduous teeth are visible.

B, Part of the jaw of a child about eight or nine years of age. The deciduous incisors and cuspidatus have been removed; the permanent incisors and the first permanent molaris have grown up.

C, In this jaw the first deciduous molaris has been removed, and is succeeded by the first bicuspis; the cuspidatus and the second permanent molaris are appearing.

D, Part of a jaw in the adult stage. The deciduous second molaris has been succeeded by the second bicuspis. The third molaris, or dens sapientiae, has made its appearance. In this series of jaws the change of the deciduous teeth for the permanent and the addition of the permanent molaris are clearly elucidated. The teeth which succeed the deciduous incisors and cuspidati are larger, and those which succeed the deciduous molares are smaller.

a diet which requires vigorous mastication. It seems evident that lack of growth of the jaws in those whom we are called upon to treat is due to the absence of the necessary function to bring about normal growth.

As far back as the year 1926 I went on record as saying that teeth seldom occupy a position too far distal in relation to the bone in which they are placed. I am now more convinced than ever that this is true. On the other hand, it is folly for us to attempt to carry teeth back, except just tipping to upright, for if we succeeded it would only further assure the impaction of third molars. Thus my reason for the removal of four premolars in the treatment of many of my cases.

I have now had ten years' experience in the treatment of malocclusion, based upon the forward translation theory, and I am never going back to the old idea that we should carry teeth forward in the alveolar process. Cases properly corrected upon the forward translation theory require no mechanical retention, and I have casts to prove my statement. I spent about seventeen years trying to obtain satisfactory results, based upon the generally recognized theory, with many disappointments.

If the forward translation theory is correct, and I am now convinced that it is, then the removal of second or third molars in cases which we treat is not going to help us much. However, in those patients who are not to be treated, the removal of third molars is, in many instances, in my opinion good procedure. In some instances the removal of second molars is indicated, but where these teeth are removed from the mouths of adults some assistance is usually necessary to bring at least the mandibular third molars into proper relation.

PAUL SPENCER, WACO, TEXAS

With efficient alignment of thirty-two teeth considered ideal, I have observed less than a half dozen such cases (white) treated or untreated, and even in these there was frequent irritation of the soft tissues around the third molars.

While this angle is not under discussion, it is mentioned as a basis for the belief that a very small percentage of arches can or ever will accommodate the normal number of teeth. If there is even a small amount of truth in this opinion, it suggests a definite handicap to the normal eruption of third molars and a theory of the causes of some impactions which may have some influence upon occlusion.

The theory that the anatomical position of the third molars makes their retention necessary, if approximal contact of the teeth anterior to them is to be maintained, is found wanting; for, when assisting with the entrance examination of several thousand negroes received at one of the army camps, I noted that third molar complications were nil, which was exactly opposite to the conditions presented by a majority of the 30,000 white men in camp. In true blood (negro) types there was from ¼ to ¾ inch space between the fully erupted third molars and the ramus, and in a small percentage of cases a fourth molar was present in normal and efficient alignment.

Lack of arch growth may be considered as one contributing cause of impactions, and the mechanical hindrances incidental to eruptions of impactions are a contributing cause of crowding of the teeth anterior to the impactions. The evidence of periods of growth of the jaws during the eruption of the teeth, presented by Hellman, is convincing, but it appears that it occurs with less frequency or to the desired extent with the eruption of the third molars.

We find a high percentage of persons who apparently need additional vertical growth. As this may and should noticeably occur with the eruption of the teeth distal to the canines, especially with the arrival of each molar,

it is evident that every case presents a different problem regarding retention or removal, as an aid to promoting a desirable and efficient occlusion.

The literature presents some evidence that growth occurs regardless of the presence or absence of teeth and is therefore not directly the result of any pressure or influence from any erupting teeth. However, an examination of models of patients between twelve and eighteen years of age, in any practice, will show to a noticeable degree, lingual displacement of the mandibular second molar and frequently elongation of the maxillary second molar, all of which may be relieved and corrected by removal of the offending impacted third molars.

Regular radiographic examination of some impactions shows a marked improvement, in some cases, as growth occurs, and in the same ratio improvement is noted in the occlusion of all the other teeth, while like observation of other impactions has shown equally opposite results.

We know of the marked change in position of the dental follicles in connection with jaw growth and the theory of displacement in transit, resulting later in malposition of the teeth or tooth. Since receiving your letter a case was reported locally, presenting an ovarian cyst, enclosing developed bone, in which several partially formed teeth were present, one of which was slightly inverted and impacted. All of which sounds very contradictory to our theory of the modus operandi of conception. I have not had time to verify the report.

Fully realizing the small value of an opinion based only on personal observation, may I add the following summary: that few persons have or will ever have ample space for third molars; that in specified types of cases their retention, for some time at least, is indicated; that removal is not indicated until after ample observation and local symptoms show that they are a detrimental influence toward promoting a desired occlusion; that mandibular third molars even if impacted may be, for a time, a helpful aid in posterior mandibular occlusions; that maxillary third molars are a hindrance to treatment of anterior maxillary occlusions, and their removal or the removal of the maxillary second molars, depending upon form, size and location of the third molars, is indicated; that substituting the mandibular third for the mandibular second molar is seldom possible or a helpful procedure in any case, that where ideal conditions prevail or there is the slightest indication that it may be attained later, all thirty-two teeth should be retained, that depending on many factors, which may vary in every case; that the third molars' presence, position and eruption may be helpful; and, in like ratio, that under adverse conditions their retention would be a hindrance to securing desired occlusion.

WILLIAM HUMPHREY, DENVER, COLORADO

Contrary to several biologic hypotheses, I still believe that the presence of impacted molars has a decided untoward influence on treated or untreated orthodontic cases.

It is obvious, from a clinical standpoint, that there is often too much tooth structure for the size of the individual jaw. The removal of an impacted molar in such a case often has a beneficial effect.

FREDERICK NOYES, CHICAGO, ILLINOIS

I believe that the third molars have a normal and a definite place in the development of the human denture, and that when development progresses normally they take their place and are important in the maintenance of the denture. In regard to their influence on treated cases, especially in the collapse of the arch in the incisor region between the ages of fourteen and twenty years, I have had a steadily growing conviction that their influence as cause of this collapse had been very greatly overestimated. I have seen too many cases in which the collapse has progressed in spite of the removal of all the third molars. Within the last few weeks I have seen a very striking case in which several years ago in consultation I advised against the removal of the third molars. I saw the case again a few weeks ago in consultation, and the collapse has continued until it has become very disturbing. There are in these cases other factors which to me explain the cause much more satisfactorily than to lay it to the influence of the third molars. I regret that at the present time I cannot do more than give an unsupported opinion in this rather casual fashion.

HARRY KELSEY, BALTIMORE, MARYLAND

Perhaps there is no phase of extraction as an orthodontic procedure that deserves more careful and conscientious consideration than that pertaining to the third molars. Modern civilization, with the unnatural preparation of food that accompanies it, has replaced the function of mastication to so great an extent that we should not be surprised when we find in a large percentage of individuals that the development of the jaws is far below that which was intended by nature. Not all these cases present malocclusion in the earlier stages of the individual's existence. Many of them present an even alignment and a normal relation of the teeth of one arch to those of the other arch, up to and after the period of eruption of the second permanent molars; while, on the other hand, many do not. So malocclusion may develop early in life, that is, in childhood, not only from lack of development of the jaws, but also from various other interferences, including hereditary influences as well as subconscious interferences, such as habits; or it may develop later, after the eruption of the first twenty-eight teeth in normal occlusion. If the latter is the case, we still cannot say that the individual is safe so far as the occlusion of his teeth is concerned.

While in some persons the development of the maxillary bones will continue to a point where the third molars can successfully erupt into a useful and normal occlusion, in many others it will not; and, when this becomes evident, either the third molars which are attempting to erupt must at this point be extracted, or the case must be left to its fate (a course too often adopted in the past). In this event the third molars will, as a rule, partially emerge from the alveolar process, where they will continue to be overlaid by the soft tissues, thus forming a pocket into which the secretions of the mouth readily enter. This creates an almost ideal culture tube in which infection readily takes place, with the consequent inflammation, swelling and pain, which

form the classic picture so well known to both the laity and the profession. This condition, accompanied also by crowding, naturally occurs about the fifteenth to the twentieth year, though it may be delayed longer or may occur somewhat earlier. It may be complicated by almost any form of impaction of the third molars, or it may occur with all of them pointing toward a normal eruption but without room to realize it. It is, in any event, a problem which must be solved, and no orthodontist is justified in discharging a patient finally, or at least from periodic observation, until it is solved, either by the satisfactory eruption of the third molars or by their removal.

I have seen a number of cases, which we should term normal occlusion, seriously affected by the development of the third molars and the effort upon the part of nature to provide room for them, which resulted in a collapse of the anterior portion of the dental arches with much overlapping and crowding. My own mouth is a good example of this. The teeth on both sides of the maxilla and the mandible moved forward so that the canines in the mandible are anterior to the incisors, and in the maxilla the lateral incisors present the same condition, being anterior and overlapping the central incisors to a marked degree. This took place well after adult life, when the third molars finally determined to make their exit from the bone. The process of their taking their position in the arch was long and was marked by an incredible amount of suffering on my part, particularly in the mandible. The usual infections occurred, and the gum was trimmed several times. Of course, today these would have been promptly extracted, in fact, they would have been extracted long before this condition arose. At least, they would have been had I held the same views then that I do now. My observations of the attempt upon the part of nature to give space in the arch for the last four molars in cases which have been treated, lead me to the same conclusion regarding them as just explained relative to untreated cases. Possibly they are more easily affected in some forms of malocclusions which have been treated than in cases which developed into a normal occlusion of twenty-eight teeth without interference, but in the end the result is about the same.

With regard to impacted teeth which cannot erupt, I believe they also can seriously affect the alignment of the teeth anterior to them; in addition there are other unfortunate sequelae, such as absorption of the posterior root of the second molar, the formation of cysts, or the maintenance of a low chronic infection.

LLOYD LOURIE, CHICAGO, ILLINOIS

I feel certain that these teeth are contributing factors in some cases of abnormal mesial positions of the teeth anterior to them and in some cases of lack of anterior occlusion, but I am equally certain that they are too often wrongly blamed for these conditions and also for relapses after orthodontic treatment. One case in particular gave me a different attitude toward this problem. In a case of Class III unilateral malocclusion, I found no mandibular third molar on the abnormal side and a horizontally impacted third molar on the normal side.

RAYMOND WILLETT, PEORIA, ILLINOIS

The influence of the third molars upon the occlusion of the adolescent and the young adult has been a problem in which I have been much interested for a long time, and one that I do not believe will be satisfactorily solved for some time to come.

During the earlier years of my orthodontic practice it did not concern me much, as I had no patients dismissed from orthodontic treatment long enough to realize from personal experience the many relapses which would occur. After about ten years in the exclusive practice of orthodontia, however, I came to the realization that either I had failed in the proper treatment of my patients or else there were influences at work over which orthodontic treatment had no control. I took this matter up with orthodontists of longer experience, and I found that many of them acknowledged that they experienced the same difficulties, and that following removal of the third molars the case that they re-treated remained in a fairly good occlusion. Some of these older men had looked far enough ahead in certain cases to remove the second molars and permit the third molars to take their places. In those cases the occlusion of the twenty-eight teeth held well. In selected cases I adopted the same practice. The results obtained were usually very satisfactory.

Within the past year a patient arrived at my office, a girl aged fifteen years, who, prior to the eruption of the second molars, had been under orthodontic treatment by a well-known orthodontist in another state. When this patient was brought to me for the consideration of further corrective treatment, I found that the maxillary left second molar had erupted in a buccal position to normal alignment with the first molar, and that the lingual surface of its crown was occluding with the buccal surface of the mandibular second molar. Plaster casts of the original condition were supplied. In comparison with the plaster casts that I made, it showed that the interpremolar and molar width of the dental arches had been well retained, but the mandibular anterior teeth were in practically their same jumbled and overlapping condition. A radiographic examination showed a serious impaction of the mandibular third molars, and also that the maxillary third molars would undoubtedly erupt in buccal malposition the same as the maxillary second left molar had erupted.

Knowing that the former orthodontist was always deeply interested in his patients, I felt that I should write to him concerning my opinion of the case and further treatment of it. I frankly told him that before considering further orthodontic treatment I had it in mind to tell the parents that it would be advisable to extract the maxillary second molars and the mandibular third molars. I am taking the liberty to quote what the former orthodontist said in reply:

"I am also very happy to have your comments on the removal of the second maxillary molars. It has been my observation that not over 5 per cent of treated or nontreated cases have ample room for the normal number of teeth. All things being equal, one would normally prefer to give up the third molars, but during the past six or seven years I have had the second molars removed in over one hundred distoclusion cases (where we had normal thirds)

and without a single exception the third molars moved into desired position, and, while proof is not available, the whole maxillary arch appeared to move distally, which was very desirable. In several similar cases, where it was apparently not possible to gain the desired root movement, especially with the incisors, the removal of the second molars was a decided aid. I wish I might say the same for the mandibular second molars, but unfortunately the results would, I think, be just the opposite. I have, however, done so with six or seven mesioclusion cases, but in each case the third molars had to be assisted materially.''

Without securing his consent, I do not feel at liberty to give the name of the orthodontist I have quoted, but I assure you that he is one of our respected fellow orthodontists.

My reason for digressing from the main issue of the question in this reply is that in the results which I have obtained, and some of my more frankly spoken orthodontist friends have experienced in their attempts to safeguard their patients against the undesirable influence of third molars upon occlusion, proof of such influence has been shown.

ALFRED ROGERS, BOSTON, MASS.

Many years ago I became convinced that in certain cases the malalignment of the four mandibular incisors could be traceable, at least in part, to the influence of impacted third molars with the pressure of erupting forces directed in the wrong direction. There have been times during this period when my conviction has been somewhat modified by observing a case of practically perfect occlusion in which badly impacted third molars were discovered. I have on occasions re-treated cases which showed malalignment of the mandibular incisors, where the third molars had not been extracted during or after the first attempt at correction of the malocclusion, and I have noticed after the second correction, when impacted third molars have been removed, that the final result has been much better. These experiences, of course, were mine many years ago. Fortunately the exodontist, through the influence of Winter and others, has developed a technic for the extraction of the third molars which is truly marvelous, having robbed this operation of its most trying features.

Since we have skilled exodontists in Boston, it is routine procedure in my practice to refer all patients with impacted third molars to the exodontist, and I am convinced that my final results so far as tooth alignment is concerned are much more satisfactory than formerly. Now, of course, there are exceptions to all these questions. First, I think we have to consider the individual and his general structure. Certain types, as you are well aware, are going to have crowded mandibular incisors no matter what you do; these are the young people who give evidence of insufficient osseous development in the maxillary bones and alveolar processes, children who seem to have an absence of sufficient mineral deposit in their bone tissue, most frequently due to faulty diet; and individuals with extremely sharp cusp definition, especially if the

osseous development is insufficient, are in that class predestined to have crowded mandibular incisors with maxillary lateral incisors somewhat displaced whether with or without impacted molars.

As an antithesis we find the rugged type with finely defined facial bones and alveolar processes and teeth with less sharply defined cusps, and it is often observed that even with impacted third molars there seems little or no displacement of the mandibular incisors.

Now we are not concerned merely with the anterior segment of the dental arches. Evil results of impacted third molars are frequently noticed in the second molar region in which the vertical position of the second molar is sometimes disturbed by the eruptive forces of the third molar being imparted to it by the peculiar position of the third molar. If the mesial cusps of the oncoming third molar contact the cementum of the root of the second molar, even slight absorption of this softer surface gives the third molar a mechanical

Fig. 2.

advantage in exerting an eruptive force upon the second molar. Now the second molar is influenced in many directions, and it depends largely upon the angle of eruption of the third molar whether the second molar is influenced to move buccally or lingually. Of course, we are all aware of the evil influences of impacted third molars beyond the question of occlusion, and I think for that reason alone it is well to resort to their removal if the operation is done by a thoroughly skillful exodontist. If there were no skilled exodontists in my locality, I should hesitate to advise the extraction of these teeth.

RALPH WALDRON

It seems appropriate at this time to show an illustration of a case from my own practice, which confirms Dr. Roger's experience regarding competent exodontists.

In November, 1926, I commenced treatment on this case; at that time the maxillary and the mandibular canines had not erupted, and the space between

the lateral incisors and the first premolars was about one-half as large as would be required to accommodate the canines. I produced what I considered a beautiful result.

A few years later, after the second molars had fully erupted, the child returned to my office with a bimaxillary protraction. The roentgenogram at that time showed a slight tendency toward impaction in both the right and the left mandibular third molars, and the maxillary third molars seemed to be developing normally. Treatment was again instituted and a result obtained which was satisfactory to all concerned, and the case was retained for about one year and then the patient was dismissed.

Some six years later (at the present time) this patient developed an extreme bimaxillary protraction, as shown in Fig. 2, which clearly shows a fourth maxillary molar on both the right and the left sides, which were apparently absent in the former pictures.

Note the forward displacement of the incisors in both the maxilla and the mandible. Also note that the left mandibular third molar is in a horizontally impacted position, while the right mandibular third molar has completely erupted in an apparently normal position in the mandible.

I sent this patient to an exodontist, who removed the third and the fourth maxillary molars on both the right and the left sides, also the mandibular right and left third molars, and the case is progressing beautifully.

I am opposed to the removal of second molars unless it is absolutely impossible to remove the third molars without damage to the second molars, and only in such a case is it a good compromise, for I find the third molars seldom come forward in an upright position and make good substitutes for the extracted second molars without orthodontic aid.

I believe I have clearly shown that an expert exodontist can, even in extreme cases, remove third molars without injury to the adjacent teeth.

B. FRANK GRAY, PASADENA, CALIFORNIA

What I have to say relative to third molars may appear rather trite. It is my belief and experience that erupting third molars may exert a deleterious effect on either treated or untreated cases of malocclusion. In the untreated cases a part of the existing irregularity may be due to those teeth. The crowding of teeth of premolar and incisor region may be due to this cause in part at least, i.e., to the persistent forward pressure of third molars.

After treatment, careful observation is necessary to note whether such deleterious influence is operative.

Impacted third molars too, in my opinion, can surely disturb the occlusion. It has been my practice to have truly impacted third molars removed.

In selected cases I believe the removal of the third molars, even if not impacted, is a wise procedure. If the remaining molars are good, there is loss sustained. Certainly any influence which tends to jeopardize the work accomplished by the orthodontist ought to be eliminated.

In Class III (Angle) cases, if the case is truly such, one would want to stop any influence tending to exaggerate the forward development of mandibular structures, so would look to the third molar as a possible contributing factor.

In the maxillary arch of the same case, when development may be desired, the retention of the third molars might be helpful.

In Class II (Angle), if truly what that classification means, the presence of mandibular third molars should be desirable, while in the maxillary arch one might wish to be rid of them.

B. E. LISCHER, ST. LOUIS, MO.

The question to be answered brings a number of queries to my mind:

(a) By influence, I assume is meant the effect of unerupted and malerupting third molars on a recently corrected dental anomaly. Many practitioners have observed that the end-results of some of their treatments of dental anomalies are not satisfactory; the anomaly tends to return, at least partially, about the time the third molars are due to erupt.

(b) Our present knowledge of this subject is very unsatisfactory. Most of our opinions, or judgments, are based on clinical observations, and these are not properly organized or supported by adequate objective data. To solve problems of this kind requires more than observations.

(c) We seem not to be certain at times whether malerupting third molars are part of the original anomaly, that is, a late manifestation of it, or whether our early treatment may have contributed to such complications.

(d) Are impacted third molars a symptom of arrested jaw development? If so, what causes the arrested jaw development? Of course, an "occlusionist" may reply "loss of masticatory function," which is a mechanical interpretation; but in some instances we may be dealing with an underlying medical problem, with general conditions of bone growth.

(e) I believe before we can safely generalize on this subject that we should gather comprehensive case histories of a large group of children. Such case histories should include records of the medical phases of their growth and development, as well as the purely dental.

(f) In certain extreme sagittal and vertical deviations (which can be accurately diagnosed) the extraction and retention of third molars is less difficult to determine than formerly. In total mandibular protraction, extraction of them is indicated; in total mandibular retraction, it is necessary to retain them, so that the patient may receive the benefit of their developmental influence on the mandible. This factor should also be considered in the prognosis of total attractions and abstractions, that is, in vertical deviations.

JAMES D. MC COY, LOS ANGELES, CALIFORNIA

It has been demonstrated to me clinically many times, both in dentures which have been subjected to orthodontic treatment and in those in which no such measures have been employed, that the eruption of the third molars, and especially the lower ones, frequently disturbs the alignment of the teeth.

I have had the opportunity to observe a goodly number of such cases, and do not hesitate to place the blame for this disturbance upon the third molars. As a precaution, in nearly all my cases I leave in position upon the lower teeth a cuspid-to-cuspid retainer until the lower third molars have erupted or have been surgically removed in those instances in which they were so badly impacted that eruption was impossible.

It is my belief that the third molars may frequently exercise a very helpful function in certain cases, especially those in which lack of vertical growth in the jaws is evident. The stimulus apparent at the time they are endeavoring to come through frequently brings about helpful growth changes. For this reason I do not believe that third molars should necessarily be removed at an early age, but in the majority of instances should be allowed to remain until approximately the sixteenth or eighteenth year. If, at this time, it seems best to remove them, they can be taken out with less trouble than when the operation is attempted with only the partially formed teeth occupying the crypts.

It is needless to emphasize the frequent use of roentgenograms. It is my practice, when dealing with this problem, to use them at least once and many times twice a year when critical cases are under observation.

BURNE SIPPY, CHICAGO, ILLINOIS

I have always advocated preserving the full complement of teeth, particularly in developing dentures whenever possible, and when extractions are unavoidable, of following with space retention when indicated. I make no exceptions to the importance of a normal complement of teeth, including the third molars.

Observations over a period of years in my undergraduate orthodontia clinic at the University of Illinois and in my own practice have caused me to believe that it is not a good thing for any denture, particularly a developing denture, to be short its normal units, including the third molars. I have made it a practice to exert effort to preserve questionable teeth, particularly third molars, and I have happily realized that such efforts in a very large percentage of cases have been fully rewarded.

With a normal complement of teeth and with normal occlusion, at twelve to fourteen years of age, whether or not there has been orthodontia management, there may follow a disturbance in occlusion from third molar influence, when the angle of the developing third molar is severe. It is at this time that deviations from occlusion, normal arch form, also unequal tooth structure of the units, unnatural angles of tooth roots, and the like give way in the interdependence of all teeth and supporting structures in providing the normal and necessary resistance to the thrust of the developing third molars.

If this resistance is all that it should be, third molars will usually erupt unless they are hopelessly impacted; for example, developing at right angles to their normal long axis, or even headed in an upside-down position, as occurs occasionally. The influence of third molars is a test of occlusion, and, as there are deviations from occlusion, so will there be disturbances; and usually the greater the deviations, the greater the disturbance.

It is conceded that the easier way out for the orthodontist in case of disturbances of the occlusion by developing third molars is to authorize or request their removal, but I am assured that in most cases it is not the better way out for the patient. Too often the fault of a relapse to malocclusion is attributed to third molars alone when the fault lies in the fact that occlusion has not been accomplished and there is, therefore, a lack of normal resistance to combat the molar thrust.

It has been my good fortune to preserve many third molars that have been condemned for extraction by persuading a patient to realize that a short period of retention will overcome the difficulties and preserve the third molars for their normal function; namely, completion of the growth of the denture, the face, and the jaws.

I believe that the time element of third molar activity is a very important factor. The wide range of variation in the beginning and the conclusion of this activity may be a hindrance or a help. There is sufficient clinical evidence to show that early and rapid third molar growth is more disturbing than a delayed and slow growth. If third molars become active soon after orthodontia management, particularly if retention has not been adequate or of sufficient duration, their activity is very liable to be a disturbing influence; but, if active management has been completed some time before this activity begins, and the inclined planes of the teeth have settled well under normal functions of the jaws, there is very little disturbance in occlusion which, in my opinion, is of less importance than the unnecessary loss of the third molar influence to complete the normal growth program of the face and jaws.

You will, I think, agree with me that the men who have so kindly given their opinions upon this question are orthodontic practitioners of vast experience and of recognized ability, yet we find a minority whose views are not so positive as the opinions of others. In reviewing minority opinion we should be ever mindful that if it were not for such opinion no advancement would have been possible in science. "For the best courage man has ever shown is daring to cut loose and think alone."

The following is a correlation of the opinion expressed by the contributors and is not one man's opinion. I may not agree with all the thoughts herein expressed, but I do admire the courage shown by these contributors who have expressed themselves according to their several convictions. They have given us food for thought, over which we should ponder.

It behooves each of us to strive to understand the other, with the conviction that the other has something worthy to be understood; and with the conviction that when mutually recognized, this something will be the basis of a complete reconciliation of our ideas upon this troublesome and important subject of third molar impactions.

A. Erupting or unerupting third molars are often responsible for the disturbance of occlusion.

B. One of the forces which occasionally upset occlusion is due to partial or total impaction of second molars.

C. Malocclusion is usually the result of a forward displacement of the teeth.

D. Impacted third molars are due to insufficient backward growth of the jaws to accommodate all the tooth material.

E. Malocclusion is due to the absence of necessary function to bring about normal growth.

F. The distal movement of teeth other than tipping to upright axial positions is liable to impact third molars.

G. In cases not to be treated, the removal of third molars is in many instances good procedure.

H. Wherever second molars are removed from the mouths of adults, some assistance is usually necessary to bring the mandibular third molars into a correct upright axial position.

I. In both treated and untreated cases there is a frequent irritation of soft tissues around the third molars, thus forming a pocket into which the secretions of the mouth, plus food, readily enter, resulting in infection, inflammation and swelling. This cannot be ignored, and some remedy must be instituted for the relief and cure of such cases.

J. The theory that the anatomic position of the third molars makes their retention necessary if approximal contact of the teeth anterior to them is to be maintained, is found wanting.

K. Lack of arch growth may be considered as one contributing cause of impaction of the teeth, and the mechanical hindrances incidental to eruption of impactions are a contributing cause of crowding of the teeth anterior to the impactions.

L. Regular radiographic examinations should be made at least once a year; all cases with a tendency to third molar impactions should be radiographed at least twice a year, until either they have erupted and are in correct occlusion or their removal has been accomplished.

M. The injudicious removal of third molars may have a deleterious effect upon vertical development in cases in which the latter is needed. In such cases the removal of third molars is contraindicated until after ample observation proves that their further retention is a detrimental influence toward promoting the desired occlusion.

N. Mandibular third molar impactions may for a time be a helpful aid in cases of posterior mandibular occlusions, and their retention in such cases is advisable, provided they have no injurious effect upon the tooth located anterior to them.

O. Impacted maxillary third molars may complicate the treatment of maxillary protractions; and their removal or the removal of the maxillary second molars, depending upon the form, size and location of the third molars, is sometimes indicated.

P. The substituting of mandibular third molars for the mandibular second molars is not a wise procedure and should be avoided if any other reasonable solution of the problem is possible.

Q. If the mesial cusps of the third molar contact the cementum of the root of the second molar, slight absorption of the softer surface sometimes

occurs, thus exerting an eruptive force on the second molar. In such cases in which no orthodontic treatment can remedy the condition, the removal of the third molar is immediately indicated.

DISCUSSION

Dr. Harry E. Kelsey.—There is one phase of this problem that I think we ought to keep in mind. A great deal of this question of the removal or retention of third molars never comes to us for decision. There are hundreds, as we all know, and thousands of third molars that are extracted year in and year out upon the necessity for their removal, and the orthodontist is not even questioned. There is a lot of evidence on this subject to be gathered from the exodontist and from the diagnostic general practitioner, just as there is on the whole question of extraction. I believe that we are too prone to think that the orthodontist sees the whole field. We do not especially in this particular instance, and there is an immense amount of material that could be gathered and should be gathered to supplement our own findings on this question.

Only recently there were three cases brought to my attention by an exodontist, on which he felt that he ought to obtain an opinion from an orthodontist before extracting. These people had come to him for extraction; and while it seemed to him that the teeth should come out (in fact the patients had come to him for extraction because they were suffering), it seemed wise to him to obtain the opinion of an orthodontist before adopting such a procedure. I agreed with him on each case, and asked him the question, ''If you do not take them out, will not some other exodontist?''

His reply was, ''Undoubtedly,'' and he added, ''These people are suffering, and the teeth would have to be taken out to give them relief.'' They were, none of them, treated cases.

I had two cases this fall presented to me for observation for the reason that in both instances the mandibular anterior arch was collapsing. They were both former patients of mine for whom I had obtained what I thought was a very good result. I looked at my notes, and in one case the last one was dated five years before and read, ''Return in six months for observation.'' In the other case there was a similar notation made six years before. It took them that long to come back, and when I asked them about it they said that they did not see any necessity to come back any sooner because everything was all right, but now that their anterior lower teeth were beginning to relapse and become crowded they had come in. It is all evidence of the same thing.

Dr. Ralph Waldron.—I have nothing further to say other than that in a case similar to the one cited by Dr. Kelsey I made it a point, in instructing the patients to come back in six months, to adopt the following procedure: I have an appointment book large enough so that there are supplementary pages on which can be written, ''So-and-So to return on such-and-such date.'' I do not trust them. I make a note of it and write to them to come in because I know they are forgetful.

Dr. Kelsey.—I adopt a similar procedure, but they do not always come in.

Dr. Waldron.—They usually come in if you drop them a line.

AN ANALYSIS OF THE ORTHODONTIC PROBLEM CORRELATED WITH RESILIENT ARCH ASSEMBLAGE AS MECHANICAL THERAPY

EDWARD M. GRIFFIN, D.D.S., NEW YORK, N. Y.

THE two outstanding, fundamental considerations in analyzing the nature of the orthodontic problem are: first, a study of the dental anomaly, intrinsically, as it pertains to the relationship of the integral factors of occlusion; second, a study of the dental anomaly, extrinsically, as it pertains to its relationship to perversions concerning growth and development of underlying structures, remotely to the cranium.

In accordance with the modern biologic concept, the nature of the orthodontic problem, in its entirety, embraces a study of the various phenomena of the processes of life itself. Biology, comprising as it does the sciences pertaining to life, envelops therefore all analytical studies pertaining to the subject of occlusion. Occlusion is the basis of all dentistry, and it is the strongest link in the chain of orthodontic diagnosis. Arch predetermination is an essential factor in determining the occlusal propensities of any given set of teeth which manifest a malocclusion for consideration of treatment. Arch predetermination is included, therefore, with many essential considerations pertaining to the subject of occlusion, in an analytical study of the masticatory apparatus designed to reveal its mechanical constitution, as conforming to laws of mechanics and physics. Such a study of this meshing machine, intrinsically, is the first essential in order that an understanding may be attained of its functional propensities, as governed by its inherent characteristics, to the secondary study, extrinsically, in order to ascertain in what manner, relationship, or under what conditions this meshing machine may function best to contribute to the welfare of the organism as a whole. Arch predetermination is one factor in the analysis of occlusion; occlusion is an essential factor regarding the mechanical constitution of the dentition; the dentition is a vital part of the organism as a whole; all factors, therefore, are intimately intertwined and interdependent in analyzing the nature of the orthodontic problem.

It is herewith essential to realize that in the orthodontic problem there presents for treatment an abnormal organism in conjunction with an abnormal dentition so far as dealing with a concept of what might be considered a status of perfection, relative to symmetry in structure or absolute harmony in functional relationship, is concerned, in offering a definition of the norm.

The purpose of the orthodontic problem is to produce a result which shall constitute the most harmonious relationship between the dentition and the underlying structures (well defined by Lundström as the apical base) in order that a masticatory apparatus best suited to the functional activities of the organism as a whole shall result. Obviously, this may mean an abnormal denti-

Read before the Chicago Dental Society, February, 1935.

tion related to abnormal bases, *but functionally a harmonious relationship or an improvement which has brought about a greater degree of harmony in the relationship of the parts if the purpose of treatment has been accomplished.*

Concisely, the purpose of treatment is to promote harmony in disharmony, relative to the relationship of cellular structures, thereby improving function.

The limitation of orthodontic treatment is to produce an efficient masticatory apparatus with the maintenance of the most satisfactory occlusion, i.e., the nearest approach to the ideal that is possible in conflict with the aberrations in development, or the irregularities of tooth structure, which cannot be eliminated as inhibitory factors to permit the maintenance of a more accurate occlusion. Until the nature of the problem can be ascertained through an adequate understanding of the interrelationship of the above aspects, extrinsically, whereby treatment shall be effective in transforming each and all structures concerned in the production of an organism which is harmoniously related in its constituent parts, to function adequately to the economy of the organism; until the operator can extensively diagnose and treat the individual by affecting structures which are *remote* as well as inherent to the dentition, he is greatly concerned in the careful study of the malocclusion as it pertains to the relationship of the integral factors which make up that malocclusion and the change which is manifested within the dentition itself as deemed essential to transform it to an individual norm.

The orthodontic problem also involves due consideration to the range of effectiveness, through stimulation, in orthodontic procedure upon cellular structures. Integral factors of occlusion may be readily moved but not the maxillae. From this standpoint, the purpose to produce harmony in relationship of structure is necessarily governed by the limitations of treatment, and orthodontic judgment is an important factor in order that the preconceived plan of treatment may be deemed feasible.

The cardinal points relative to the orthodontic problem having been stated, it is herewith apropos to proceed with explanation of an analysis of the dental anomaly in order to evaluate characteristics which offer a basis for determination of a preconceived plan of treatment. Viewing the anomaly intrinsically, we seek to determine the occlusal propensities of the dentition at hand and the degree and character of change in alveolar arch proportions which may be advisable in correlation with the relative position and status of development of the structures which comprise the apical bases of the jaws, respectively, as defined by Lundström. Limitation in the length of this presentation does not permit explanation of various procedures which may be deemed advisable in an adequate diagnostic procedure; but an outstanding factor, namely, the analysis of the occlusal propensities of the dentition and the adoption of a particular occlusal relationship, which, it is deemed, shall contribute most satisfactorily toward the establishment of a harmonious relationship between the dentitions and the apical bases of the jaws, is herewith elucidated.

I believe that the Stanton surveying process will pass the test of scientific investigation as offering the most accurate procedure for arch predetermination with production of accurate graphic portrayal of the occlusal propensities of the dentitions. At this juncture it is essential to quote Dr. Stanton: "Arch prede-

termination does not show how much the superstructures of the head are deformed, nor does it indicate any plan of treatment. If the orthodontist, after considering the conditions, decides that he will try to establish normal occlusion for a given case, then the technic will give him the exact form and dimensions of the alveolar arch into which the teeth will fit and give normal occlusion; or can it answer the question as to whether the teeth will stay in normal occlusion or whether it would have been better to adopt some other plan of treatment.''

It should be explained herewith that arch predetermination is not based upon the premise that there is one ideal, stereotyped alveolar arch form for the human dentition; that variations radiating from such a centralized form are to be construed as degrees of variation from the norm. Reference is offered to Dr. Stanton's work to emphasize forcibly that the orthodontist cannot look to a stereotyped form as the norm; that arch forms are as varied as there are combinations of the integral factors of occlusion, as determined by their combined tooth substance, revealed in pattern, size and anatomical characteristics. Arch predetermination involves a technic, therefore, which is based upon physical science wherein an engineering problem is involved. The problem is to test the occlusal propensities of the dentition so far as occlusion is determinable, as based upon the physical properties of the teeth, as revealed in pattern, size and anatomical characteristics. It does not take into account what disturbances or variations in occlusion may be demanded by nature in consequence of the functional activities of the meshing machine in coordination with the individual peculiarities, i.e., aberrations in development of underlying structures.

It does not allow for the contingency that occlusion, necessarily, may be permanently modified in accordance with so-called ''Nature's plan'' which may be accounted for by correlated variations from the biologic consideration.

However, I refer to the excellent explanations of Dr. Dewey on ''Constancy of Cusp Positions as Related to Facial Form'' to repeat, ''that cusp position has been more constant than any other part of the facial and cranial elements and that cusp position is the most important factor in studying deviation from the normal . . . . malocclusion can be more accurately treated and diagnosed from cusp position alone, than from any other single plan of diagnosis.''

But the observer in orthodontics is astounded to find such prevalence, in degree of severity and in numbers, of malocclusions in the face of the above statement—herein it is obvious that the great prevalence of abnormalities of basic underlying structures also characterizes the individual. The anomalic status of one structure, whether resulting in consequence of hereditary growth forces of inherent origin or from environmental forces of extrinsic origin, may inhibit the establishment or inhibit the maintenance of a nearer ideal occlusal relationship which would be possible as far as a test of the occlusal propensities of the dentition per se is concerned. It is essential, therefore, that the preconceived plan of treatment should emanate as orthodontic judgment of the operator in consequence of due deliberations pertaining to the status of development and relationship of the entire dentofacial structures and remotely to the cranium. This judgment should precede the making or application of the diagnostic map unless the survey is made for examination of the information which it reveals,

with reservation that the preconceived plan for treatment shall be based upon various factors as mentioned, not upon the occlusal propensities of the dentition only.

I wish to state in consequence of my studies, designed to evaluate adequately the application of the Stanton surveying process in orthodontic diagnosis, that the science and art of orthodontia embrace a study of various phenomena pertaining to growth and development; that no appliance, no mechanism, no surveying apparatus can be more than an instrument in the hands of the operator as he endeavors to assist nature in correction of abnormalities by influencing the

Fig. 1.

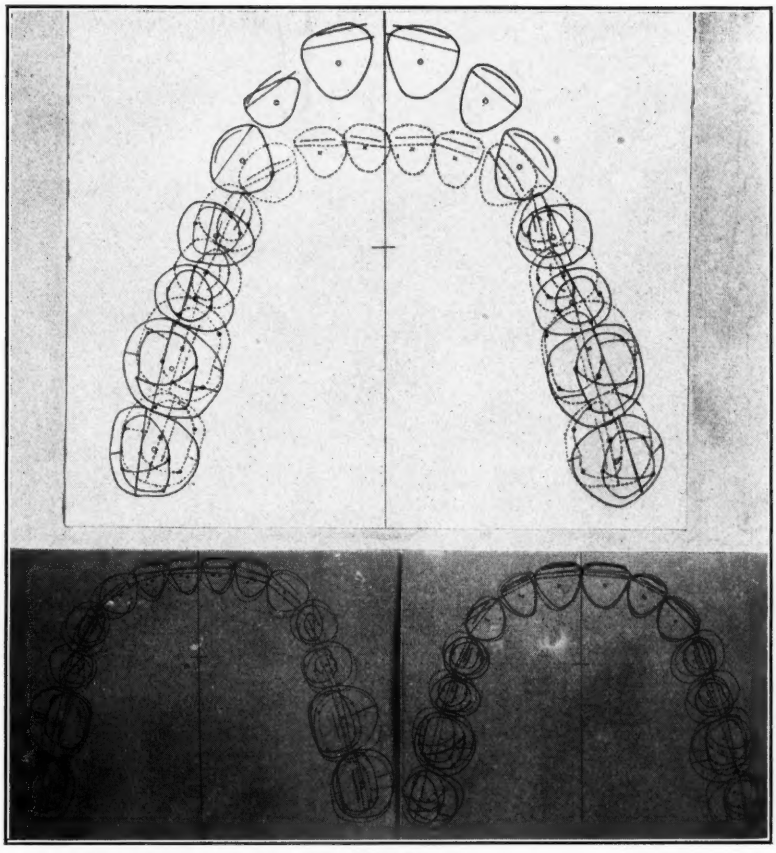


Fig. 2.

Fig. 1.—Case 1, map of occlusion.

Fig. 2.—Case 1, dotted lines showing ideal occlusograph map superimposed with map of complete result in solid line.

metabolism of cellular structures in the infinitely complex living organism. The surveying process will assist in the determination as to what degree or in what manner the integral factors of occlusion are susceptible to normal occlusion—nevertheless, in the acceptance, rejection, or modification of the information as revealed by the map, the operator must first of all exercise sound orthodontic judgment in its application to his preconceived plan of treatment. By his judgment, he must render decision relative to the opening or closing of spaces in all conditions pertaining to disharmonies arising through congenitally missing teeth, extractions, anomalies, or what shall be the most satisfactory positioning

of the teeth in the lesser disharmonies pertaining to total tooth substance in one jaw, relative to that of the other; the amount of expansion which is feasible to attempt, the judgment concerning the limitations of treatment under various conditions of health; conditions imposed by age, sex, idiosyncrasies, etc., all of which are beyond the pale of mathematical formulas or instrumentation in the sense that diagnosis could be determined upon information as revealed through these per se.

As concrete illustration, it is apparent that if a predetermined arch form as projected from the integral factors of occlusion which were diminutive in size, presented a form in which it would be obvious that a condition of macroglossia would produce perpetual separation of the teeth, it would probably require surgical reduction of the tongue if normal occlusion could be maintained.

It is apparent in cases in which both alveolar arches present the absence, congenitally, of several teeth, or in cases in which one jaw presents a decided

Fig. 3.

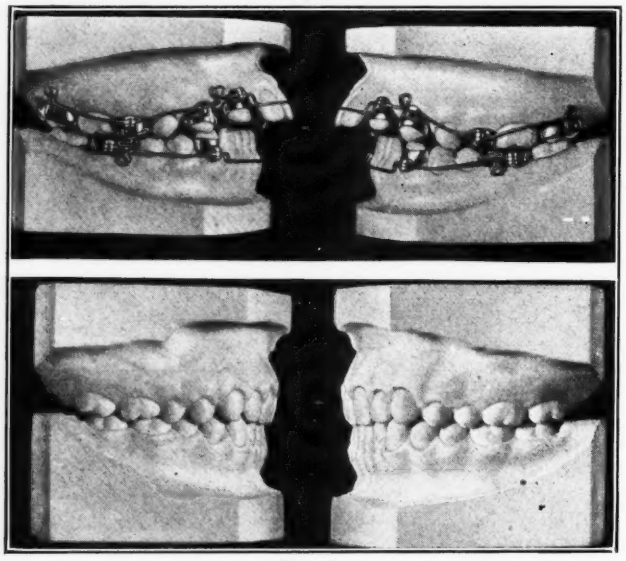


Fig. 4.

Fig. 3.—Case 1, casts of original malocclusion.
Fig. 4.—Case 1, casts of completed case.

discrepancy in the amount of tooth substance as compared with the other, a dentition presenting a full complement of tooth material would be impossible since the underlying structures could not be developed to alveolar arch proportions which would support such a masticatory apparatus.

In accordance with the previous statement, in establishing harmony in disharmony, which may mean an abnormal dentition related to abnormal bases, and essential consideration, that of establishing the "individual norm" in occlusion as a factor in the orthodontic problem, is given. It is essential to visualize the dentition in its status of malocclusion, as transformed to one in a status of normal occlusion, with the reservation that normal occlusion shall be essentially that relationship of the teeth which is conceived to be the basis of all dentistry, but with such variations in the relationship of the teeth and their arrangement

in such alveolar arch form as shall be productive of an "individual norm." The purpose of this norm is an assemblage of parts best constituted to the functional activities of the organism as a whole. While Angle stressed so emphatically that adequate development, with its reflected harmony and beauty, was possible for the individual only with a full complement of teeth (including the third

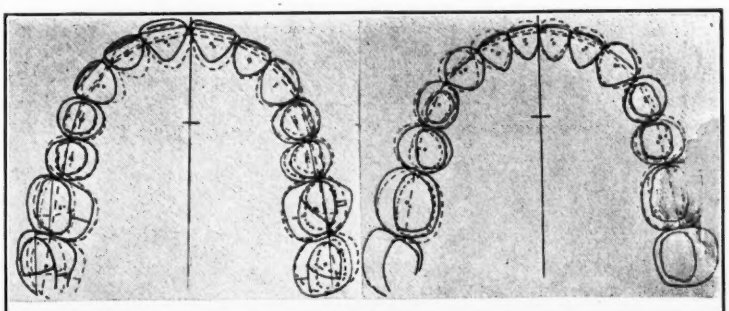


Fig. 5.

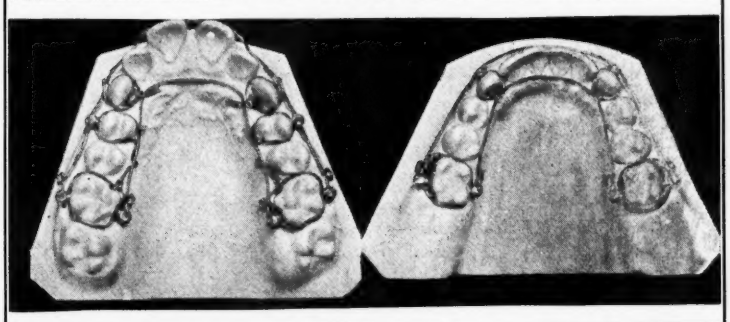


Fig. 6.

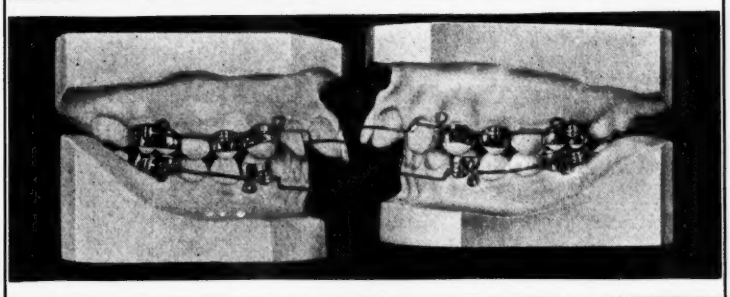


Fig. 7.

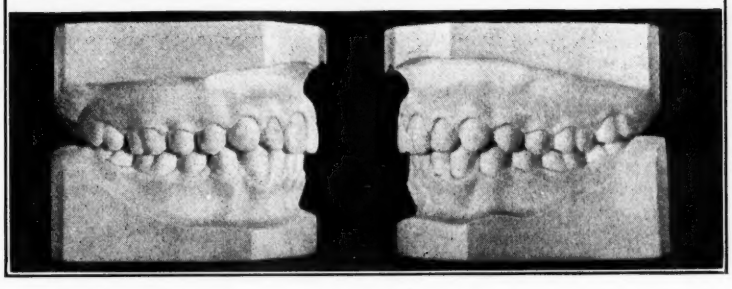


Fig. 8.

Fig. 5.—Case 2, check of completed result with occlusograph map as explained in Case 1.
Fig. 6.—Case 2. Class II, Division 1 malocclusion.
Fig. 7.—Typical assemblage for maxillary and mandibular dentition.
Fig. 8.—Case 2, casts of completed case.

molars), yet he qualified this idealism by stating that probably nature never did make the individual ideally perfect in every particular. The establishment of an individual norm in accordance with Conklin's definition offers, therefore,

more latitude in modifying the occlusal relationship than that of the Angle school. As Conklin states, "such occlusion conforms with correlated activity of many parts of the individual organism—it reflects the result of physiologic

Fig. 9.

Fig. 10.

Fig. 11.

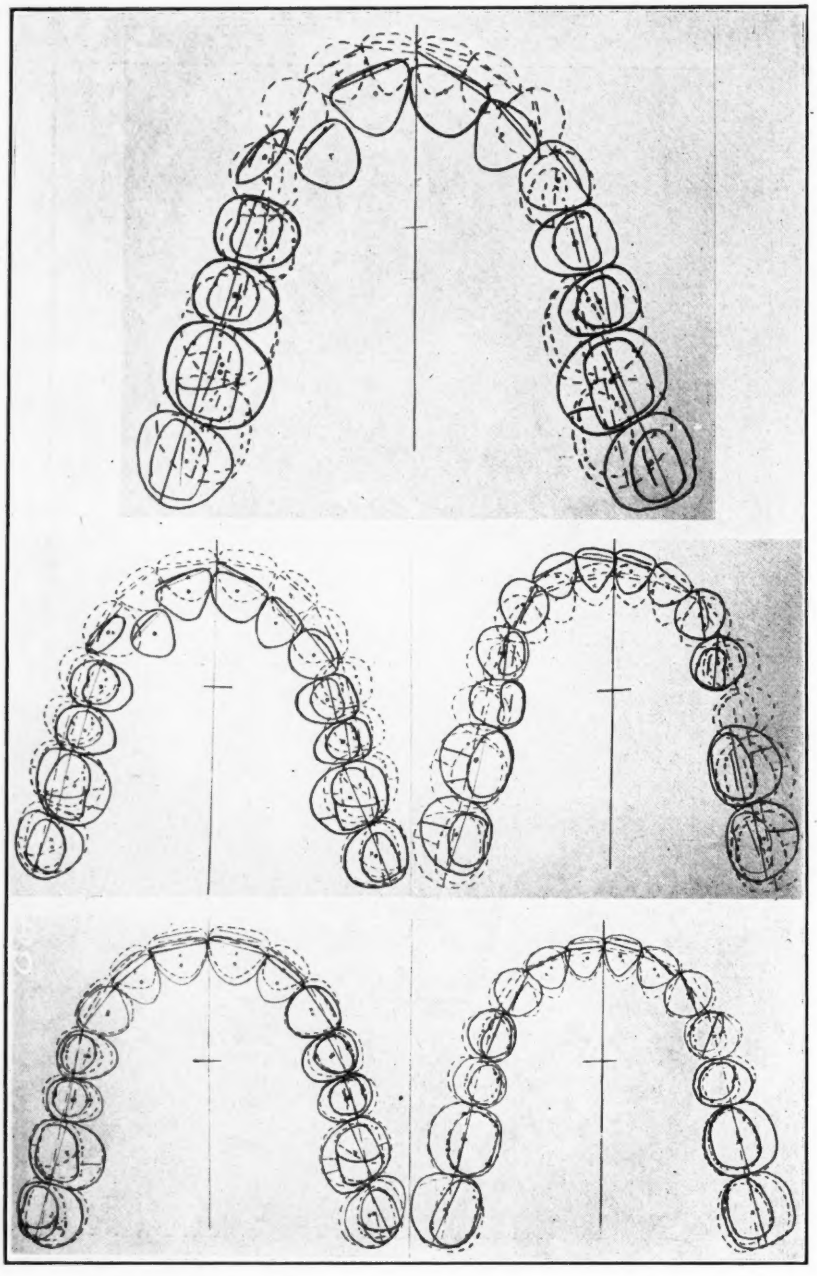


Fig. 9.—Case 3, map of malocclusion.
Fig. 10.—Case 3, treatment sheets showing minimum tooth movement.
Fig. 11.—Case 3, check for accuracy of completed case.

processes; it transcends all endeavors in aiming at a concept of average or majority rule; it is that form of occlusion which is best adapted to the needs of the organism as a whole."

Fig. 12.

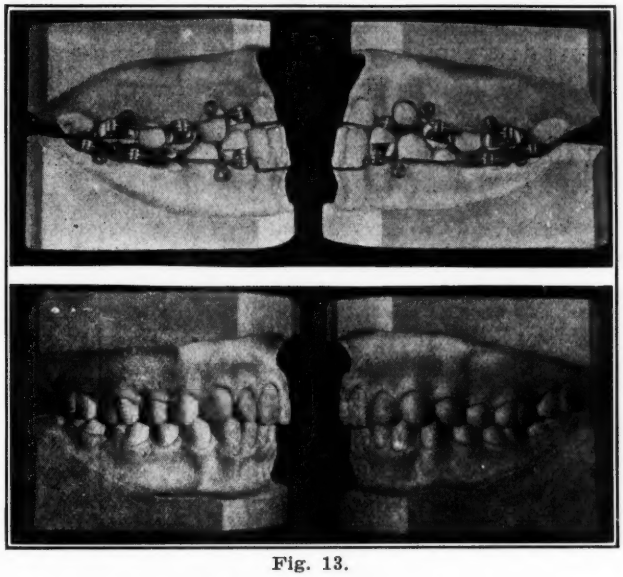


Fig. 13.

Fig. 12.—Case 3. Class III, casts with appliances.
Fig. 13.—Case 3, casts of completed case.

Fig. 14.

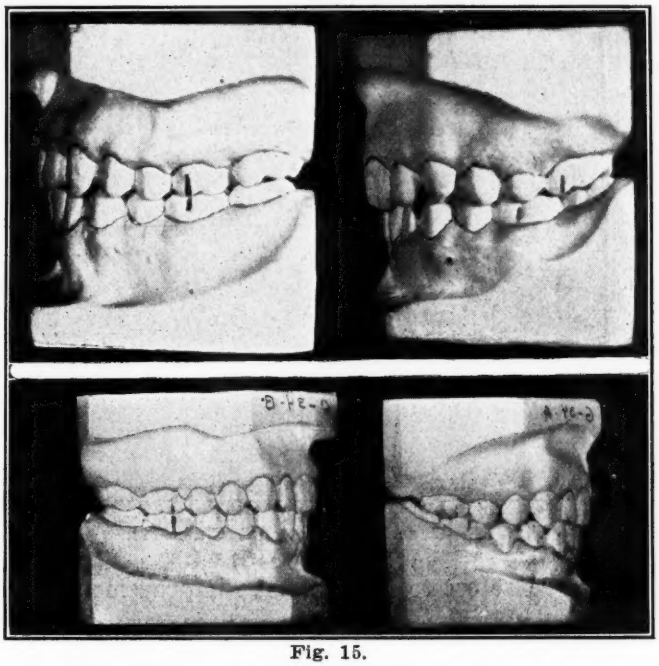


Fig. 15.

Fig. 14.—Case 4. Class I with Class III propensities. Check for accuracy of result of treatment which was completed at time when writer was not informed of surveying procedure.
Fig. 15.—Case 4, same as Fig. 14, casts of original with completed case.

It is evident in certain cases presenting with extreme aberrations in development that prognosis to establish a modified occlusion will assist in the promotion of harmony in disharmony of structural relationships.

While I approve the plan in treatment which offers due consideration for the latitude in modifying the occlusion to conform with the establishment of an individual norm, as explained, still it is the exceptional case, for it is comparatively seldom that the plan of treatment calls for the compromise occlusal rela-

Fig. 16.

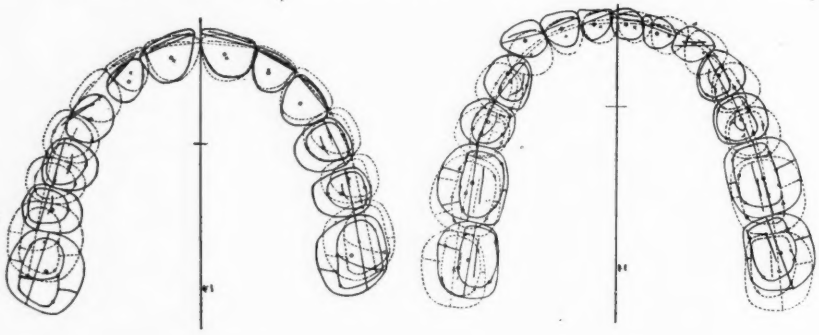


Fig. 17.

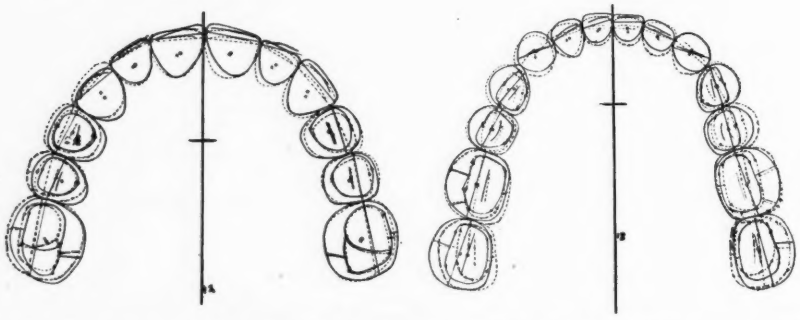


Fig. 16.—Case 4, treatment sheets showing required minimum tooth movements.
Fig. 17.—Case 4, check for accuracy of result with occlusograph map.

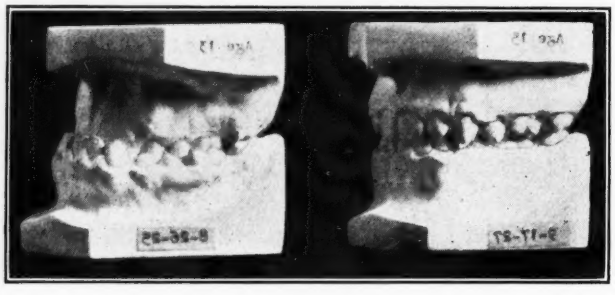


Fig. 18.—Case 5. Functional Class III.

tionship of the integral factors to facilitate the improvement of harmonious relationship as a result of treatment. In the vast majority of cases the plan of treatment still conforms to the establishment of normal occlusion with the full complement of teeth in accordance with the ideals as taught by Angle.

The following treated cases are offered as illustrative wherein I deemed it advisable to establish normal occlusion with the full complement of teeth. The cases present typical Class I, II, III according to Angle. In making the diagnosis it was deemed that the integral factors of occlusion presented occlusal pro-

pensities, as determined by the occlusograph in the Stanton surveying process, which would be desirable as an occlusal relationship in harmony with the apical bases of the jaws. The respective relationships and alveolar arch forms were checked after treatment with that of the occlusograph as set up before treatment in arch predetermination with the results as shown, simulating to the degree indicated by the discrepancies between the dotted and the solid outlines. I do not wish to infer that the use of the surveying process as herewith shown is necessary but that it is decidedly helpful in teaching procedure and, to the man recently trained in orthodontics, to prevision the changes which are to be instituted through treatment. (Case 5 was a similar check-up in which case I did not have access to the use or test of the surveying process at the time of treatment.)

The next three cases illustrate the nature of the orthodontic problem in explanation of the previous statement that the operator by his own judgment must render decision relative to many factors concerned in prognosticating

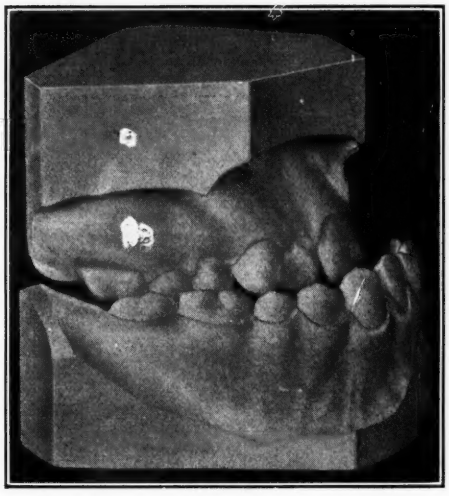


Fig. 19.—Case 6. Severe Class III.

modified occlusion which shall contribute in harmonious relationship to underlying structures. Case 6 presents a functional Class III in which the maxillary first premolars are congenitally missing and the maxillary dentition is satisfactorily positioned relative to the apical base of the maxilla. I deemed it advisable to harmonize the occlusal relationship with the apical bases of the maxilla and mandible, as well as the integral factors of occlusion, by removing the mandibular teeth which corresponded to those congenitally missing in maxillary teeth. Case 7 illustrates the very satisfactory occlusion which is indicative of the occlusal propensities of the dentition as revealed by the occlusograph, determined in consequence of size, type, pattern and complement of tooth structure, but which is obviously impossible in consideration of a feasible amount of development of the maxillary arch and a reduction of the mandibular arch, in expectation of producing a harmonious relationship of both, relative to facial structures. A survey shows herewith that by a feasible expansion of the maxillary arch and likewise a reduction of the mandibular arch anteroposteriorly to the extent as shown by the removal of a first premolar, bilaterally, the resulting compromise occlusal relationship could be attained, not allowing for any reduction in

mandibular position through condylar adjustment; however, I deemed the case sufficiently disharmonious to warrant surgical resection.

Fig. 20.

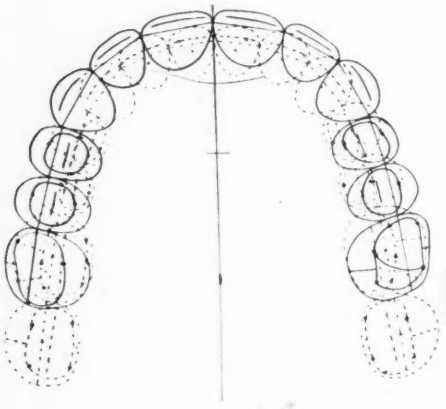
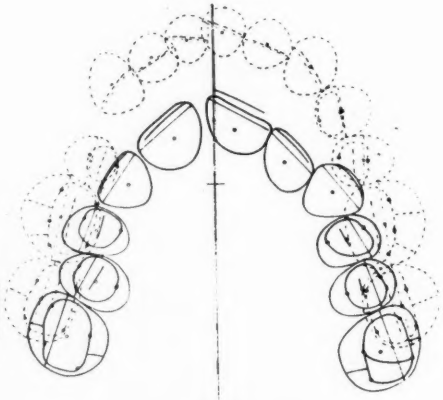


Fig. 21.



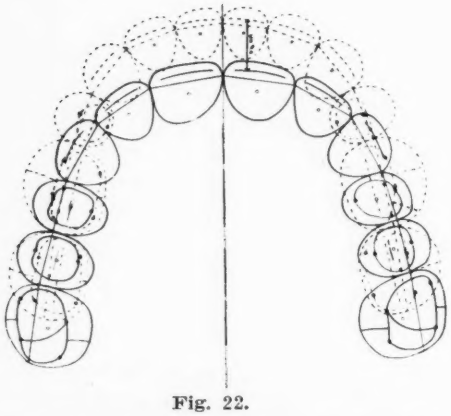


Fig. 22.

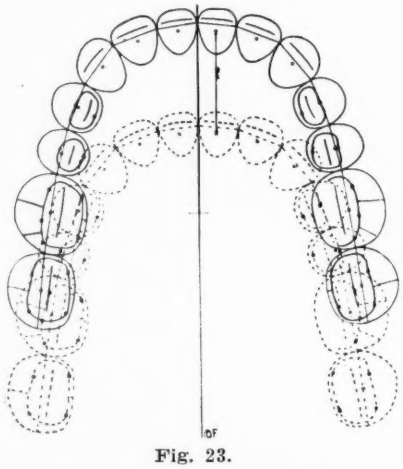


Fig. 23.

Fig. 20.—Case 6, showing excellent occlusal propensities, map of occlusion.

Fig. 21.—Case 6, map of occlusion.

Fig. 22.—Case 6, map showing compromise treatment by extracting mandibular first premolars.

Fig. 23.—Case 6, treatment sheet of mandibular dentition by retraction.

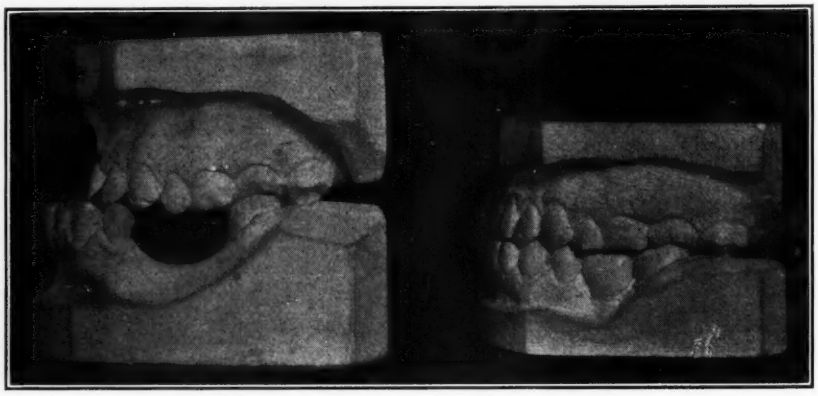


Fig. 24.—Case 7, surgical resection case.

Case 8 illustrates the establishment of comparative harmony from disharmony by recourse to surgical resection, from the practice of Dr. Meyer Hoff-

man, operating with Dr. C. G. Burdick as surgeon. This case illustrates the previous statement that the orthodontic problem may show a result in which an abnormal dentition is established in conjunction with abnormal bases but a harmonious relationship has been effected.

The second section of this article deals with the nature of the orthodontic problem from a study of the dental anomaly as it pertains to its relationship to perversions concerning growth and development of the underlying structures—remotely to the cranium.

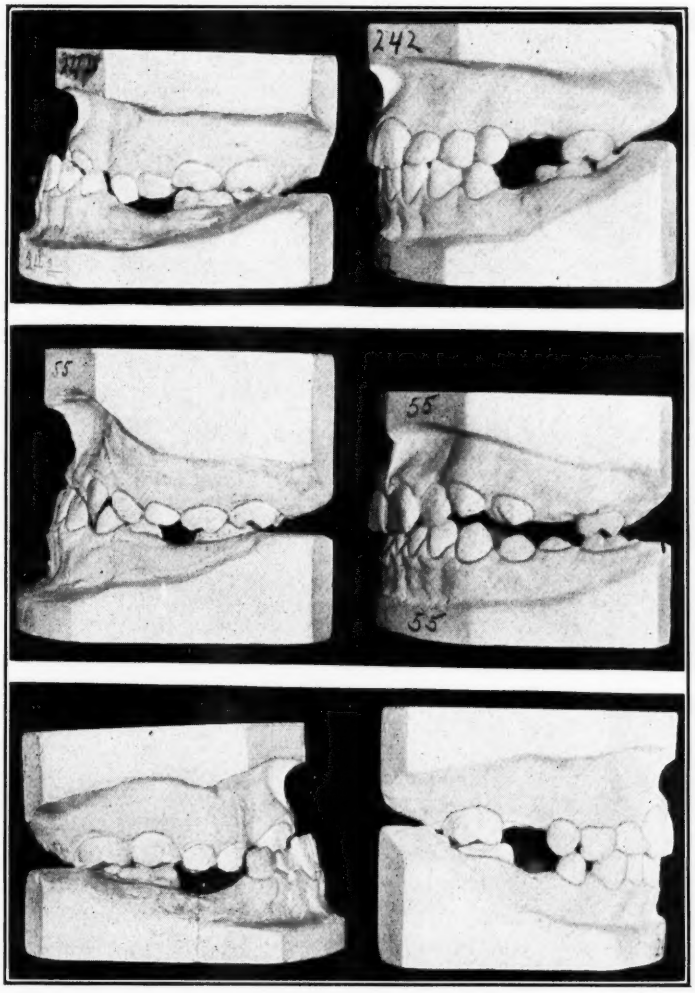


Fig. 25.

Fig. 26.

Fig. 27.

Fig. 25.—Case 8, treatment progressing to meet requirements of positioning dentition relative to apical bases.
Fig. 26.—Case 9, same as Case 8.
Fig. 27.—Case 10, same as Case 9.

As previously stated, it is essential to ascertain in what manner, relationship, and under what conditions this meshing machine may function best to contribute to the welfare of the organism as a whole.

The justification for adopting criteria, in the light of present-day knowledge, for distinguishing individual cases behooves due consideration to uncer-

tainties as revealed by research pertaining to the determination of the individual optimum for the dentition relative to the head. The problem presents four main considerations as outlined by M. L. Tildesley:

1. By what standard is rightness to be measured?
2. What is the cause of divergence from the standard?
3. What means are to be used in bringing divergence to conformity?
4. Is divergence due to circumstances possible to change?

I wish to give consideration to No. 1 and No. 3 and to add to No. 3 the additional query, "What are the *limitations to the means* at our disposal to be used in bringing divergence to conformity?"

By what standard is rightness to be measured? It is apropos herewith to say that cephalometry has not revealed what is to be considered the norm of the head as correlated with innumerable anatomic points. The relation of the denture to the head is still more distant. Due to the fact that such determination involves the complexity of growth and development and that this is further complicated by the intermixing of racial characteristics, the complexity of the problem is of such proportions that the ability to predetermine or to recognize the individual optimum, if once attained, is an attainment which, in the opinion of the greatest anthropologists, will not be within the field of human knowledge at least for generations to come.

Dr. T. L. Woo who has demonstrated so adequately by actual accurate measurements of a series of 900 late dynastic Egyptian male crania on which 25 characters were measured on homogeneous bones of the cranium, left and right, offers the following conclusions: "The human skull is definitely and markedly asymmetrical. It is not a question of the bones of the individual cranium differing from a symmetrical type, but the type cranium itself is asymmetrical. Some dimensions of the cranial bones have dominance in the right side, some left, but in the whole, the right has dominance."

In attempting to create a statistically sound and readily applicable standard by which to diagnose abnormalities of such complex structure, as the face, Dr. Marion L. Tildesley explains the statistical snags to be encountered in the approach by biometrics. She says: "Perfect correlation would exist if and when one dimension was less than its mean value by the amount of its standard deviation, all other dimensions were similarly less than their own means by the amount of their own respective standard deviations, etc. A perfect correlation means a cause and effect relationship, but never in any group is this relationship found to exist between the proportions of the face nor for any part of the body."

The various characters of the skull are not highly correlated so that perfection in one respect guarantees practical perfection in all. The type skull (corresponding in all respects with the mean) is not symmetrical. Such assumption is not justified.

The latest conclusion, as published from Krogman's research, reveals, "Biometry has not solved any of the orthodontists' problems. It has given to the serious student of orthodontic problems a most efficient tool with which to work. It has given him some idea of the frequency of a given trait in the specific sample studied, the average; it has given him some idea of the variability of that

trait, the range; the mean deviation, the standard deviation, etc. He can be reasonably certain that his conclusions, statistically drawn and statistically verified, can be applied to all the population represented by the sample. But biometry can never do more than define the normal as a statistical fiction, nor indeed can it presume to analyze underlying causal factors."

The foremost exponent of constancy of faciodental relationship is Simon, whose orbitocanine law is based upon asserted dependency of the orbitale and canine point. This constancy has been challenged by Broadbent, Connelly, Stanton, Wolfson, Dewey, Hellman, and others. Ample proof has been offered to show that the orbitocanine relationship is extremely variable. Krogman's in-

Fig. 28. Fig. 29.

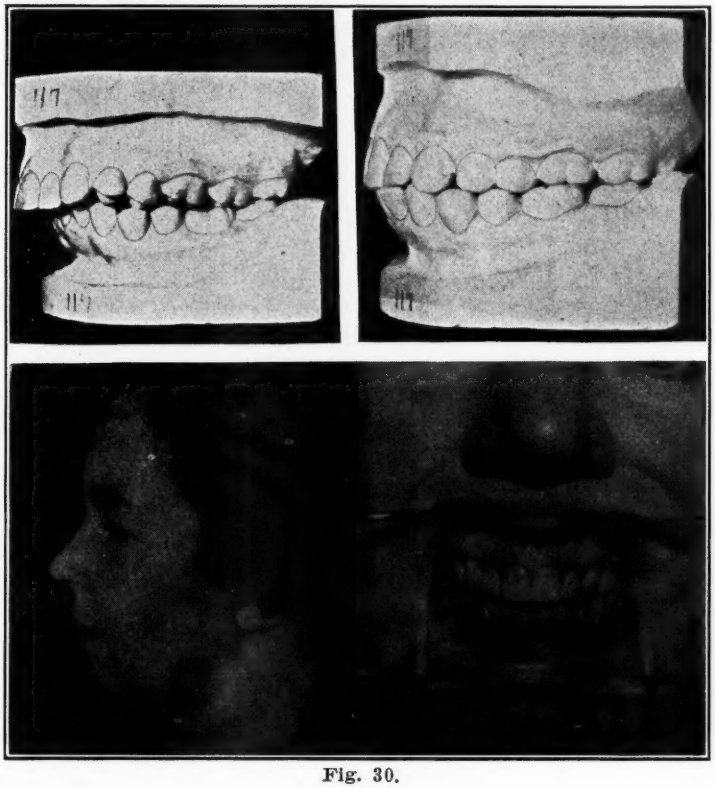


Fig. 30.

Fig. 28.—Case 11. Severe Class II, Division 1.
Fig. 29.—Case 11, cast of completed result to meet apical base requirements as explained.
Fig. 30.—Case 11, views of completed case.

vestigations, likewise, concur in this finding and he summarizes: "There is no dependable relationship between any facial point or plane passing through that point, and any tooth in either the head (cephalometric-orbitale) or skull (craniometric-orbitale). Specifically, orbitale-canine relationship is not constant and orbitale plane is extremely variable."

Referring specifically at this juncture to the Simon analysis of dental anomalies, I present the significant statement of sound reasoning by Lundström. "Gnathostatically planned treatment stands or falls accordingly as the mandibular and maxillary bones are normal or not. If malocclusion is an anomaly, locally restricted to the denture, then gnathostatic diagnosis will present a re-

liable starting point for treatment. But if the malocclusion is not this, but a manifestation of an anomalous condition of the apical base, visible in the

Fig. 31.

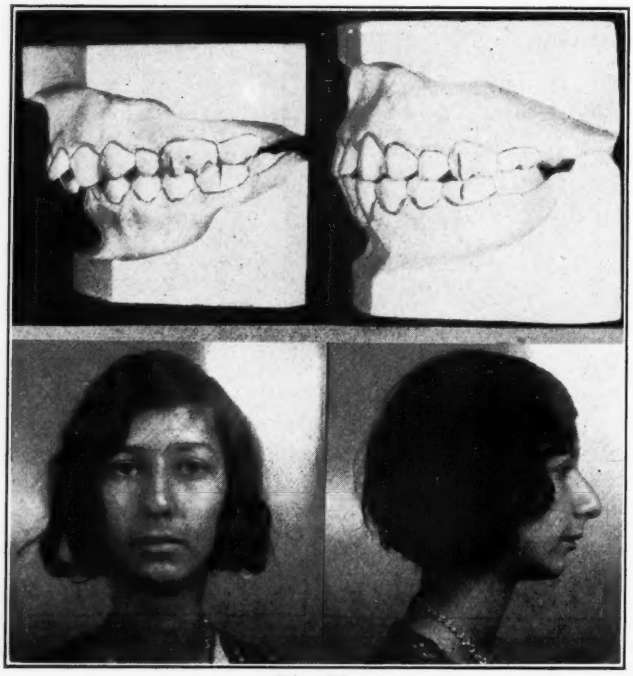


Fig. 32.

Fig. 31.—Case 12, casts of original and completed case. Severe Class II, Division 2.
Fig. 32.—Case 12, photographs of patient before treatment.

Fig. 33.—Case 12, photographs of patient after treatment. Completed case shows extensive corrections intraorally with slight effect on profile. Position of dentition with apical base as explained.

denture only, then the basis is unreliable. Gnathostatic systems are based upon the conception of an ideal, assuming that the teeth ought to be placed in definite relations to certain planes of the head. *Even if* it can be proved that in ana-

tomically perfect cases the sagittal position of the denture is uniform, we are not entitled to conclude that the same positions in relation to the planes are to be attained in abnormal cases.''

Simon proposes a graph of the sagittal section of the palate. From a composite of norms, he proposes that the orthodontist evaluate abnormality of any angle. The plot is read from elevations from the Frankfort horizontal plane —hence diagnosis will show whether the palate is too high, or too far from the Frankfort plane; whether it is correctly inclined from front to back and whether the prostheon is too far forward or not. The futility of such an assumption is shown by Stanton in his ''A Critique of Simon's Diagnostic Methods,'' in which wide variations in the norm of this line is shown from Huxley as to linear distance from the Frankfort plane, the angulation and the anteroposterior rela-

Fig. 34.

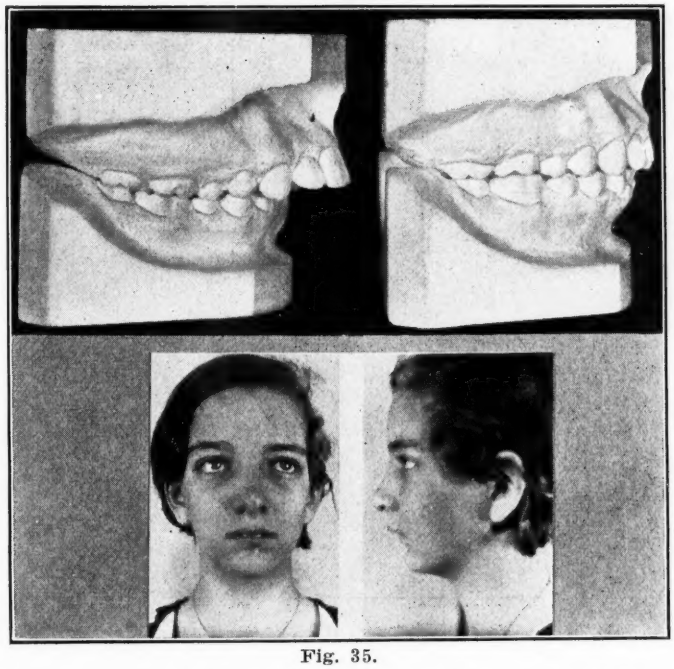


Fig. 35.

Fig. 34.—Case 13. Severe Class II, Division 1. Casts before and after treatment.
Fig. 35.—Case 13, photographs of patient before treatment.

tions, demonstrating it to be useless for diagnosis unless accompanied by a table of variations of the norm from childhood to adult life.

Ferris has shown forcibly in diagnostic illustrations the asymmetrical proportions in cranial outline and has stated that the majority of malocclusions show unilateral developmentally retarded potentials in all dimensions of the bones of the head and face on the defective side; that we are without a basis for measurement as to regional developments from which to build any positive conclusions or classifications of malocclusions.

Furthermore, as I previously stated, the decided limitations to affect remote structures through treatment must be given due consideration; so, even if we used a proper biometric table and precise anthropologic measurements and they told us that the denture belonged so many millimeters in front of its present posi-

tion, we know of no way to accomplish such changes with orthodontic appliances. Hellman tersely questioned in his criticism of gnathostatics, "Can you move a maxilla?"

In view of the evidence submitted herewith to substantiate the fact that the individual optimum for the denture relative to the cranium cannot be predetermined or recognized, it is desirable to determine *upon what basis is orthodontic diagnosis desirable in the light of present-day knowledge and present-day conditions which seem to place malocclusions second only to caries in afflicting the youth of our country.*

In reiteration of the orthodontic problem, it is to produce a result which shall contribute the most harmonious relationship between the denture and the underlying structures, defined so excellently by Lundström as the apical bases. In order that the masticatory apparatus best suited to the functional activities of the organism as a whole shall result, the dentition must exemplify the plan

Fig. 36.—Case 13, photographs of patient after treatment. Completed case shows pronounced effect of treatment on profile. Apical base requirements as explained.

of occlusion which is construed to be the individual norm. In true centric position of the jaws, registering corrected occlusal intercusping, it shall manifest a harmonious relationship to the underlying structures and present balance of the facial features according to individual characteristics.

Viewing the nature of the orthodontic problem in this manner, it is apparent that it is necessary in order to formulate a plan for practical and reliable diagnosis again to consider the revelations of research pertaining to growth and development of the jaws and face, particularly as concerns a starting point from which to measure or determine the relative positions of the jaws to each other; second, as concerns their positions respectively to underlying structures, remotely to the cranium.

I wish to opine that the teaching of Angle still reigns supreme pertaining to the relationship of the jaws, namely, the constancy of the first permanent molars, as being the most reliable guide to mark the correct mesiodistal position

of the jaws, unless disturbed by mutilation. This postulate has not been disproved. Second, as regards the relative status in development and position of the jaws respectively to the associated facial structures and the cranium, the approach is suitably made radiographically.

The orthodontic problem presents two concepts for analysis from a study of growth and development. First is the relative position of the facial structures as they show emergence to a greater or lesser degree from beneath the brain case. This involves the status of growth of the brain case and underlying facial structures, the study of comparative growth rates in degree as well as speed during respective periods with the center or anterior border of foramen magnum construed to be the center of growth activity, and the area contiguous to the basocranial axis as that which manifests lesser change in applying mensuration to respective outlying anatomical points which show greater change and instability.

This study is promising from the approach by scientifically accurate radiography which produces extreme accuracy in duplication of exposures for compari-

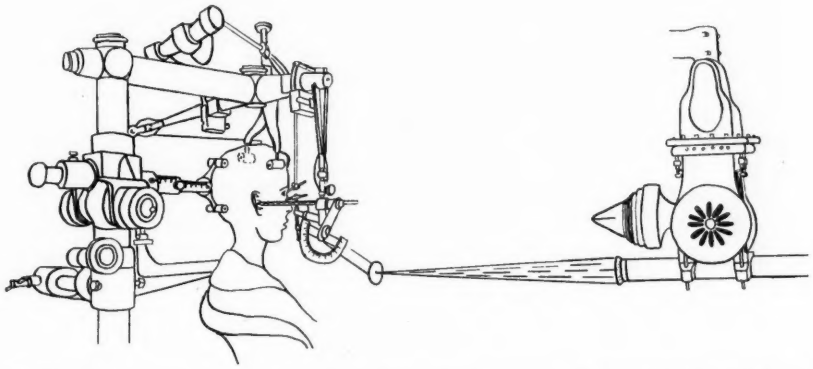


Fig. 37.—Odontometer, construction for extreme accuracy in duplicating radiographs.

son of changing measurements and proportions. This study has been pioneered and is being carried on extensively by Dr. Broadbent through the Bolton research at Western Reserve University. In conjunction with my associate in teaching, Dr. Meyer Hoffman, and assisted by consultation with the White Engineering Co., I have completed construction of an instrument to initiate studies as explained. The second concept concerns the same data regarding the more restricted fields of the maxillary structures and herewith, according to the Angle postulate the constancy of the developing position of the first permanent molars, offers the reliable guide for mensuration in determination of mesiodistal relationship of the developing jaws or relative positions respectively to underlying structures.

The orthodontic problem presents the requisite, from the standpoint of esthetics, that the facial features shall present balance with the distinction that faces are not alike, but, in profile, should present balance in proportion as is pleasingly characteristic for the individual. Only in a true bimaxillary protrusion probably, would it be justifiable purposely to mutilate an ideal occlusion for esthetic purposes. These are comparatively rare except when produced by

faulty orthodontic stimulation wherein the dentitions have been drawn abnormally forward relative to the underlying apical bases of the jaws. Great caution is necessary to guard against such reaction of forces in appliance assemblage and adjustments, lest the alveolar arches be stimulated to develop dentitions which are abnormally forward. I agree with Grieve: "that we have not fully realized the tendency to a forward drift of the teeth—that the teeth are never too far back in relation to the base except, possibly, when there has been mutilation or some unusual condition."

The processes of growth, as revealed by research from several investigators, indicate that stimulation of the alveolar structures of the maxilla to increased activity promotes increment to be added from behind, causing the face to grow backward, but in consequence of this, the face migrates forward. This has been stressed by Hellman in his studies on the growth of the face, and concurring views have been revealed by studies through different approaches by Hunter, Humphrey, Keith, Campion, Brash, Todd, and others.

Clinically, then, it is important so to apply the stimulus that the developing structure adds the increment posteriorly, *without drawing the teeth of the anterior segments forward by a direct stimulus in advance of the general facial development.* The anterior teeth should maintain or be brought to a satisfactory position relative to the apical base, concomitantly with treatment, whereas if the anterior teeth are directly moved anteriorly beyond a satisfactory basal relationship, a bimaxillary protrusion is produced. It is therefore not consistent to say that tooth movement posteriorly is conducive to contraction of insufficiently developed structures but rather, to the contrary, proper stimulation may well result as contributory to development. The mechanistic features of the growth posteriorly have been explained by Todd as follows: "It is a little difficult to understand at first how this space is obtained in the hinder part of the upper jaw. When it is observed, however, that the face is so hafted to the cranium that the forwardly expanding brain case carries the facial mask with it and hence increases the available space ventral to the vertebral column, one can realize how this accommodation is provided." Clinically, this mode of growth is apparent from the standpoint of the examination of third molar areas after treatment in which the teeth have been moved posteriorly in the production of neutroclusion in centric position. It is not generally the result to find by such treatment that the third molars have become impacted or more essentially so, but to the contrary, ample development still accommodates their position for proper eruption.

The third section of this article is a consideration of the orthodontic problem as it pertains to appliance assemblage in the treatment as presented. The application of mechanical therapy requires the control of applied mechanical stimulation to influence cellular metabolism for the production of tooth movement in three planes; horizontally, anteroposteriorly, and vertically. It is the control of such stimulation, with the production of such tooth movements and with the explanation of the mechanical nature of the assemblage, that the accompanying cases as well as all others shown in this writing, having been treated by the resilient arch technic are offered.

In explanation of the technic of resilient arch assemblage, from the standpoint of considering the wide scope of mechanical principles which it inculcates, I offer my own references upon this subject as well as articles by Drs. S. Harrington Stein and Gabriel Roger Vogelson. Such references may be readily found in the *Journal of the American Dental Association,* the *Dental Cosmos,* and the INTERNATIONAL JOURNAL OF ORTHODONTIA AND ORAL SURGERY. In brief explanation of general considerations, however, as the illustrations attending this presentation give ample evidence, the technic of resilient arch assemblage is essentially a standardized form of mechanical construction as applied in the treatment of various types of malocclusion. It is standardized from the standpoint that radically different types of assemblage are not applied; however it is

Fig. 38.

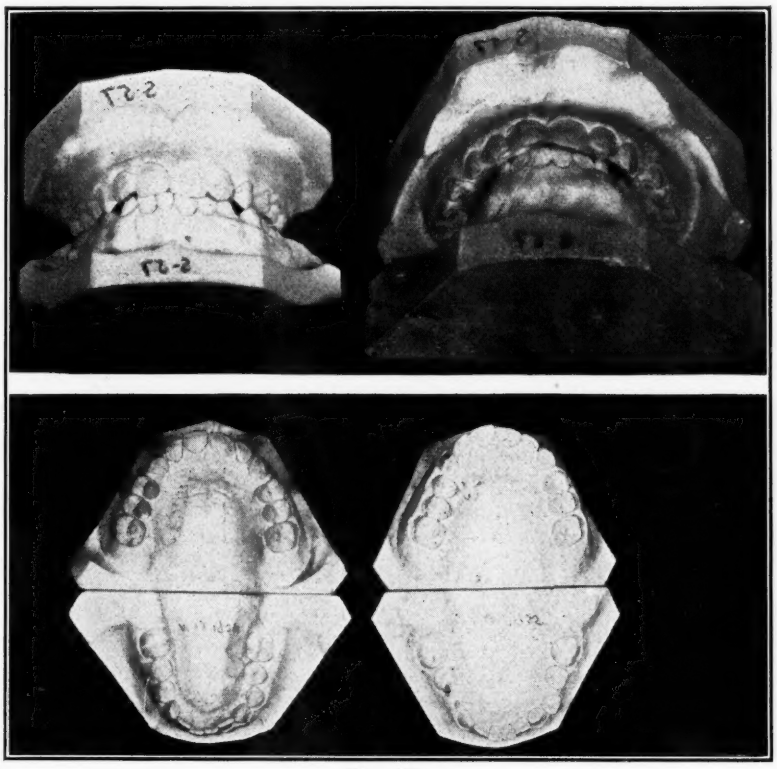


Fig. 39.

Figs. 38 and 39.—Case 14, casts of original and treated case to show tooth movement in horizontal plane.

not to be construed as essentially manifesting specific construction to simulate a universal appliance, for the reason that construction is varied in innumerable designs to adapt the assemblage to meet the requirements of the particular case in hand. Concisely, the essential aim in appliance assemblage is the most efficient application of mechanical principles to influence cellular activity, not the narrow concept of sponsoring the use of any particular appliance.

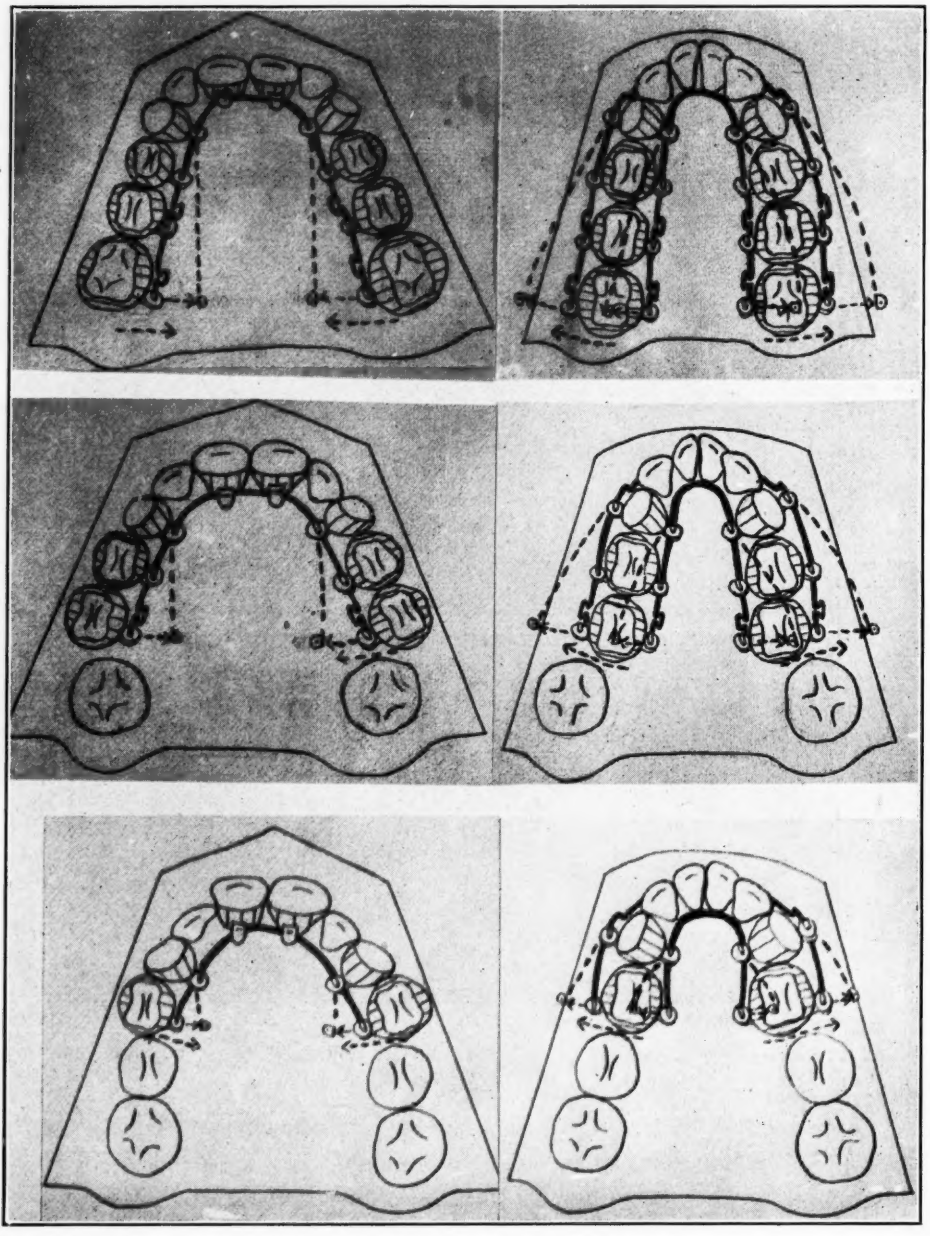
Supplementing the writings to which reference has been made concerning the technic, I offer the following illustrations of mechanical construction and adjustments, as well as the case reports, to clarify the control of tooth movement in three planes, which is essential to the mechanical therapy consideration of this paper.

The technic employed for the development of structures in the horizontal plane by the application of resilient arches of the lingual and labiobuccal types, in conjunction or separately, has been amply described in previous writings. Herewith, the variations in arch construction, to meet the specific requirements

Fig. 40.

Fig. 41.

Fig. 42.



Figs. 40-42.—Case 14, resilient arch assemblage and change in application to meet requirements of tooth movement.

of the case as reported, are given to illustrate the mechanical problems in stress and resistance which are involved and to show mechanical applications for tooth movement in an unusually difficult positioning in the horizontal plane. The lateral segments of the lower dentition are in complete lingual version to those

of the upper; the maximum cuspal interference or abnormal cuspal interlocking buccolingually is manifested. The mechanical requirements for positioning to produce normal cusp relationship are maximum stress laterally through the

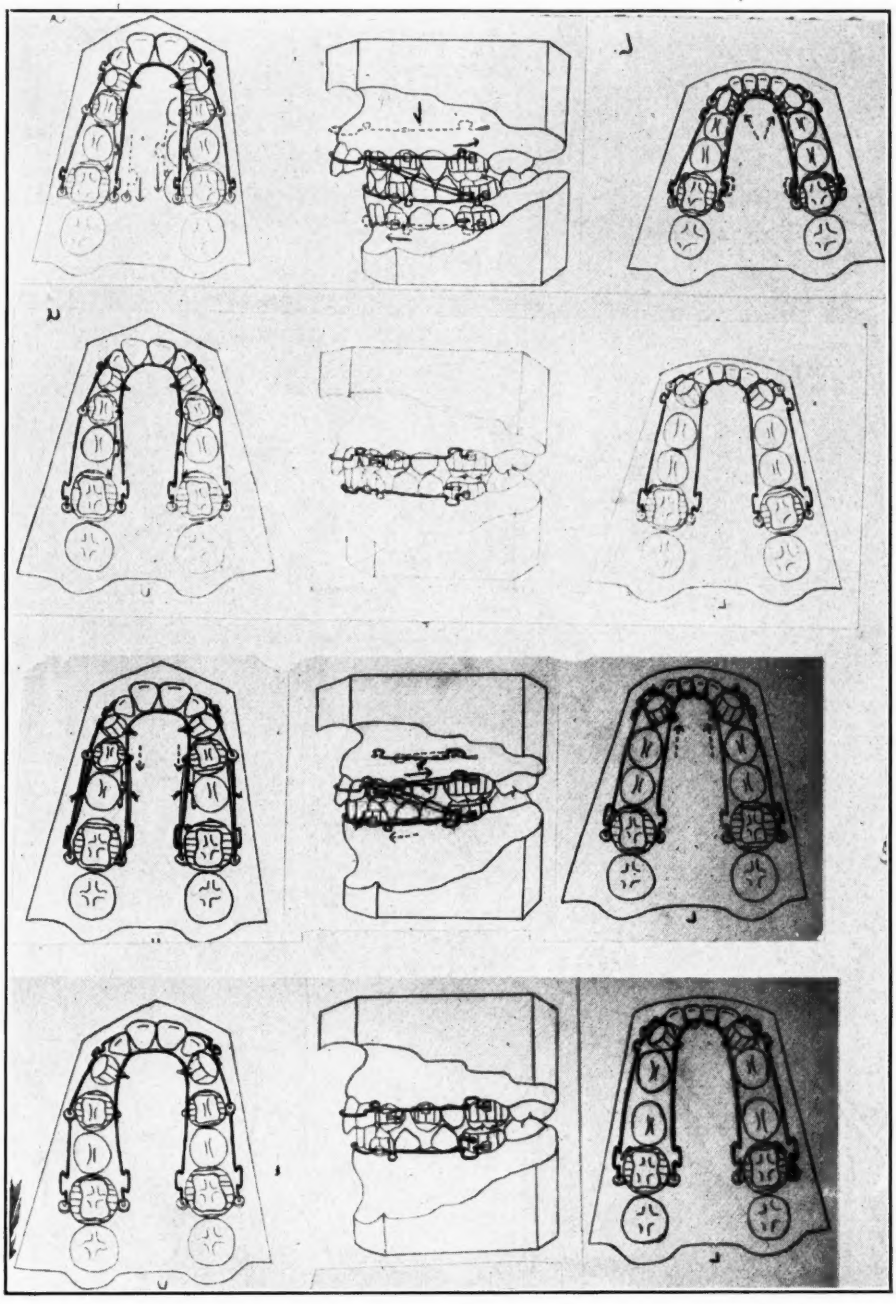


Fig. 43.

Fig. 44.

Fig. 45.

Fig. 46.

Figs. 43-50.—Resilient arch assemblage for moving maxillary dentition posteriorly and mandibular dentition anteriorly in bodily movement.

elasticity of flexion from the arches against the minimum area of resistance or tooth substance to be moved, in reciprocal application, lingually and buccally. The bite is opened by incorporating within the assemblage this feature so that the maxillary lingual arch may be applied concomitantly with the other arches

in producing maximum reciprocal pressures. The attachments, lingually positioned to afford terminal attachment to the maxillary lingual arches, offer this

Fig. 47.

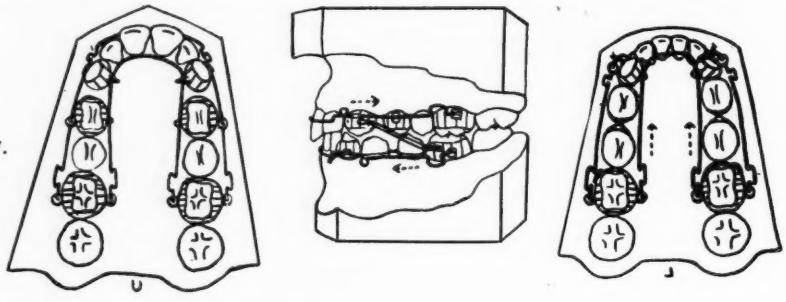


Fig. 48.

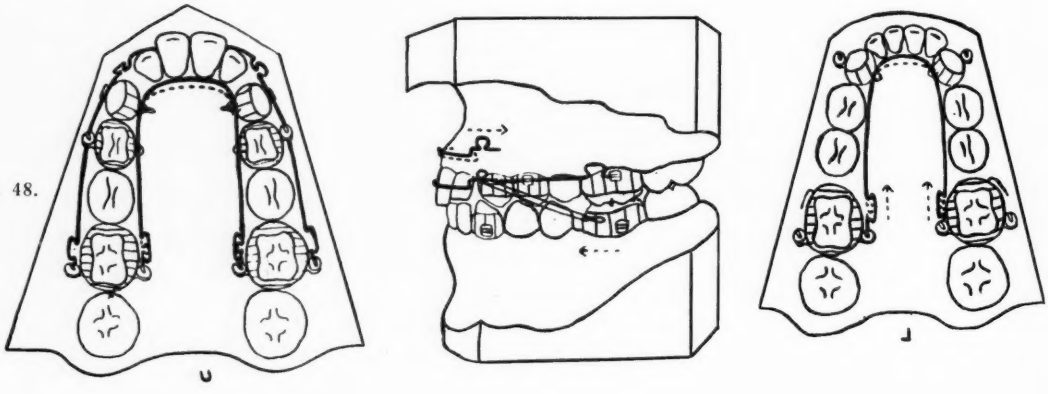


Fig. 49.

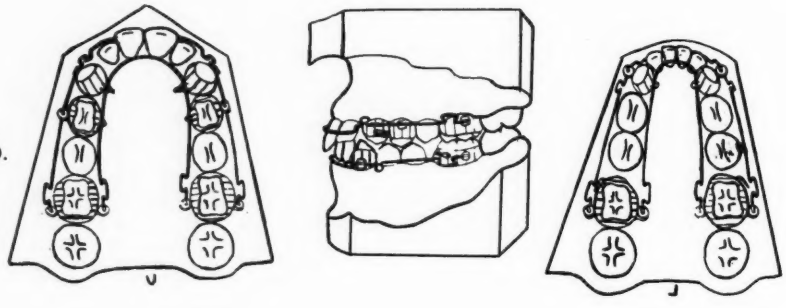
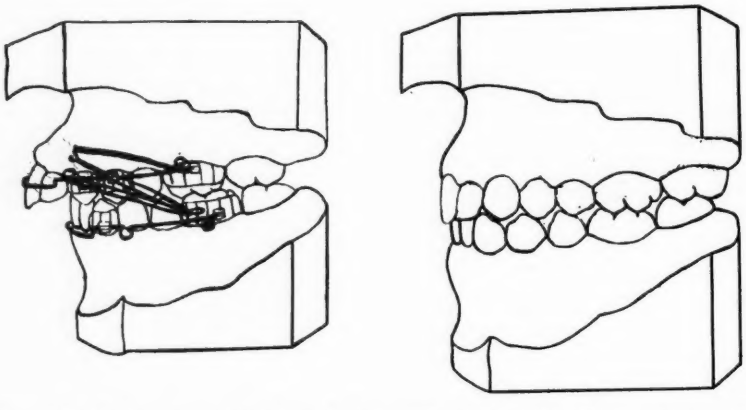


Fig. 50.



provision for raising the bite; equalization being effected with the anterior segment by properly positioning the snap clasps lingually on the maxillary central incisor bands.

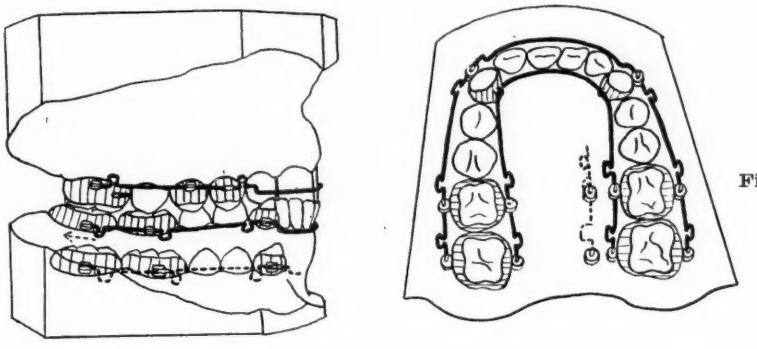


Fig. 51.

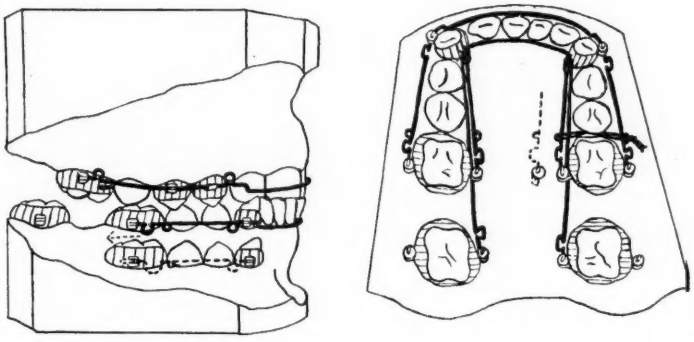


Fig. 52.

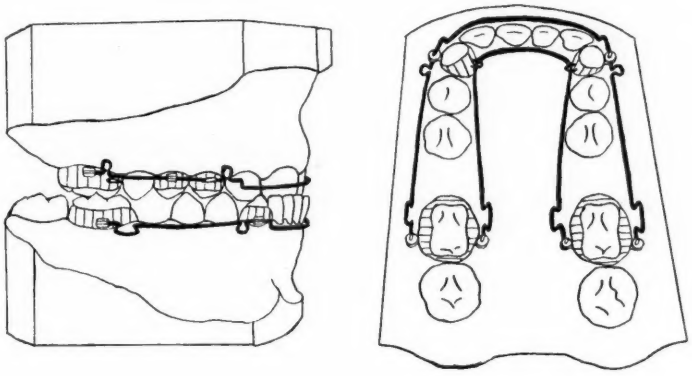


Fig. 53.

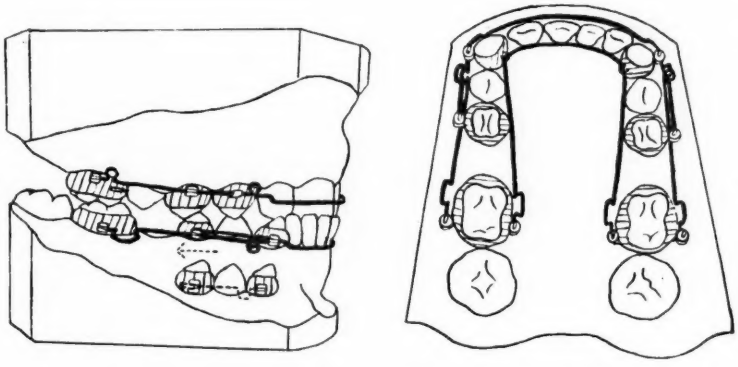


Fig. 54.

Figs. 51-61.—Showing movement posteriorly of mandibular teeth.

The arch construction is varied first by using larger wire, or 0.028, and Alloy Q or a wire of high modulus of elasticity. The entire flexural stress of the arch terminals are positioned against the molars reciprocally. The S elastic is also applied to assist in the cuspal reduction. The molars having been reduced to normal intercusping, buccolingually, the occlusion offers self-retention so far as these teeth are concerned. The arches are then reduced in length and applied

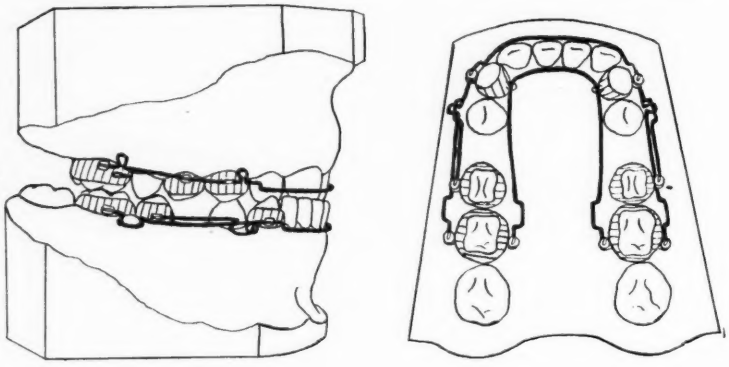


Fig. 55.

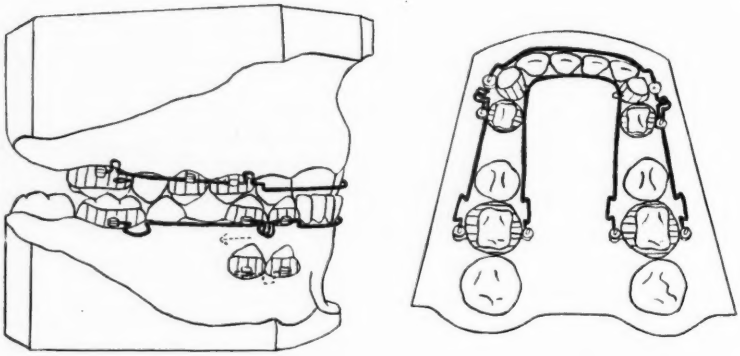


Fig. 56.

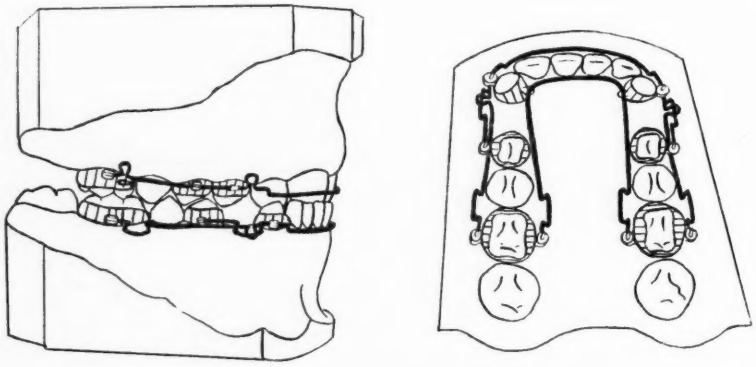


Fig. 57.

likewise to the second premolars. These are reduced in like manner and the arches are then reduced and applied in like manner for the reduction of the first premolars. The case at this stage of treatment is shown after a period of six months.

The technic employed for the control of bodily tooth movement in the anteroposterior plane as applied in certain posterior occlusion cases is herewith illustrated. The typical assemblage consists of buccolingual arches and lingual

arches assembled in conjunction with six banded teeth on the maxillary teeth. The first molars and first premolars are connected by flexible stabilizing wires. The lower arches are assembled with four banded teeth, the first molars and cuspids. This typical assemblage is shown repeatedly in accompanying illustrated cases. The maxillary buccolabial arch may be applied with or without the yoke which is a rigid bar attached at the junction of the terminal block with the arch wire, and the other end is terminated as a free hook to engage an intermaxillary elastic to the lower molar. The yoke intensifies the intermaxillary action. The maxillary buccolabial arch is positioned loosely so that interference is not offered as the molars move posteriorly by the arch passing over the anterior segment. This arch must be very free, sliding through the attachment on the first premolars, unpinned, and through the sleeves on the cuspids. The loops

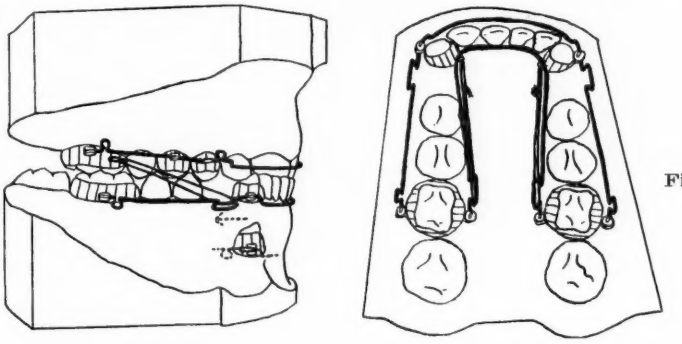


Fig. 58.

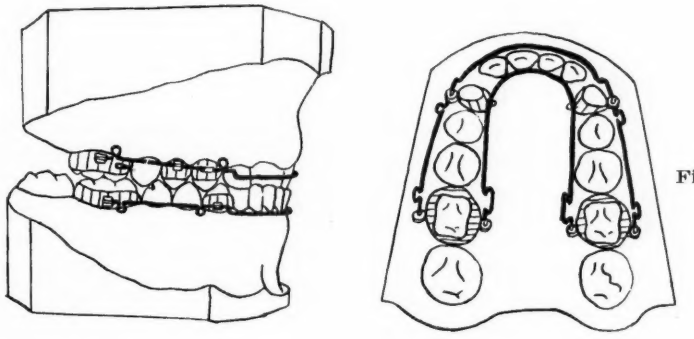


Fig. 59.

of the stabilizers are forced open slightly by the beaks of the adjustment pliers. The lingual arch is positioned so that no interference to the movement of the molars, posteriorly, is offered. Pressure is exerted posteriorly by the lingual arch if reciprocal pressure anteriorly against the anterior segment is not contraindicated. The teeth of the lateral segments are moved posteriorly in series and in the development of the mandibular arch, the mandibular teeth are moved forward concurrently in accordance with development attained and proper positioning, relative to the apical base. The maxillary molars having been moved to considerable clearance from the premorals, the premorals are moved posteriorly to the molars by traction which is exerted through the application of steel ligatures which are applied from the loops on the arches in front of the terminal attachments to the seats on the premolar bands, bucally, and to the eyelets on the same bands, lingually. The ligatures are twisted for traction mid-

way between these points of application. The intermaxillaries must be worn constantly to prevent the molars again resuming their positions mesially. The stabilizers are unhooked at the molar terminals when the premolars are to be moved.

The cuspids are moved independently by intermaxillary action from the hook on the distoincisal angle to the mandibular molar. The remaining anterior teeth are then positioned by pressure from the buccolabial arch as it is tightened across the anterior segment, and intermaxillary action is continued. The lingual arch is also employed at this juncture by bowing it lingually and ligating to the anterior teeth.

Fig. 60.

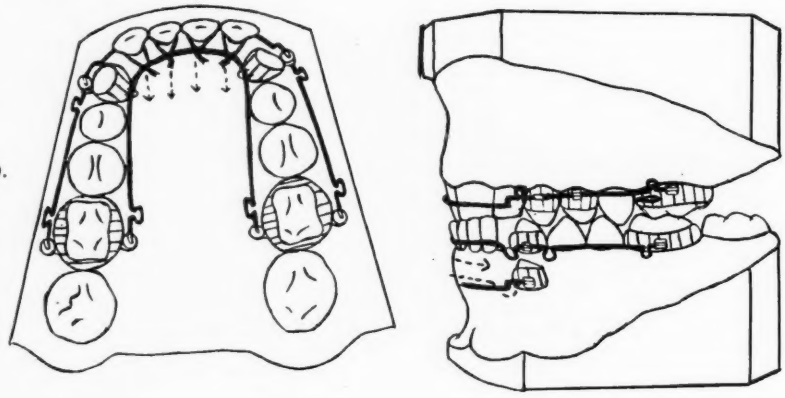
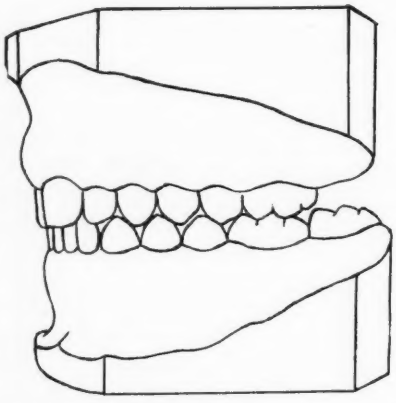


Fig. 61.



In development of the mandibular arch, the cuspids are moved anteriorly and laterally as desired, by adjustments through the loops and locking the attachments. The incisors and premolars are positioned in curvature arch alignment by accessory steel ligatures to the buccolabial arch and pressure is adjusted to the lingual arch. The premolars are moved anteriorly to the cuspids by successive tying with silk cable to produce traction, the tie being made over the attachment to prevent slipping, gingivally. The molars are moved anteriorly last by intermaxillary pull to the maxillary arch with the mandibular arch freed so that no interference to the movement is offered.

Movement Posteriorly of Mandibular Teeth.—Buccolabial and lingual arches are applied with terminals upon the second molars. The loops are opened buc-

cally and lingually between the first and the second molars. Thus, all teeth anterior to the second molars serve as group anchorage in resistance to the movement, posteriorly, of the second molars. The second molars having been moved posteriorly, the arch sections, buccally and lingually, from first to second molars, are removed and a separate arch extension, from the lingual attachment on the second molar to the eyelet on the lingual surface of the cuspid band, is placed to prevent drifting anteriorly of the second molars during the movement, posteriorly of the first molars. The loops are next opened buccally and lingually between the first molars and second premolars, a ligature having been tied from the eyelet on the buccolabial arch, bilaterally, to the eyelet on the

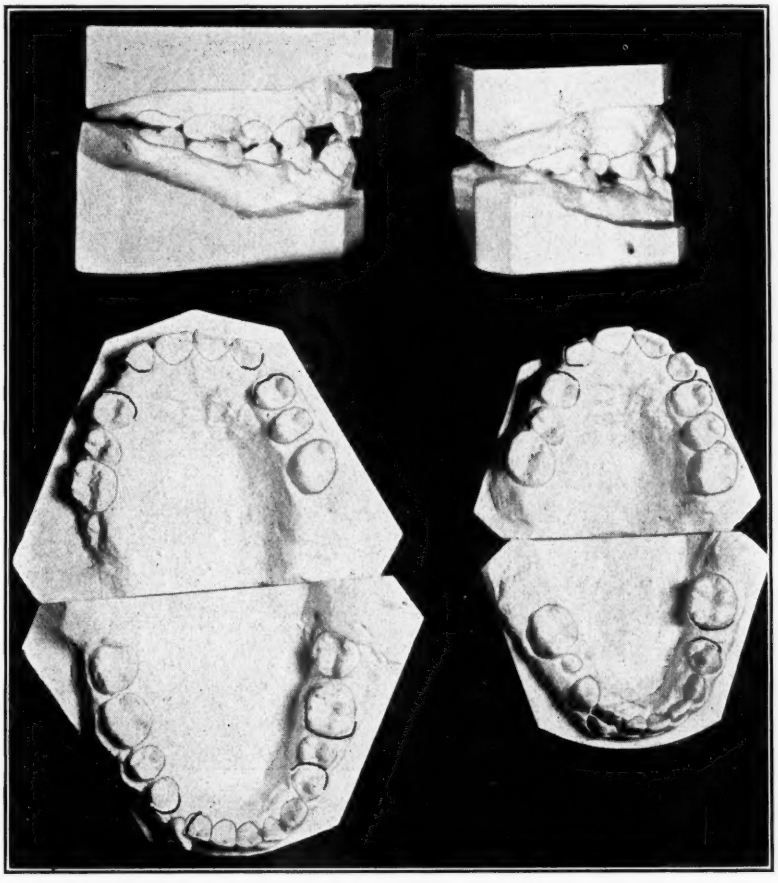


Fig. 62.—Case 15, movement posteriorly of maxillary and mandibular lateral segments in case presenting four impacted areas.

lingual arch, posteriorly, through the embrasures of the teeth. Thus all teeth anterior to the first molars serve in group anchorage as resistance to posterior movement of the first molars. The first molars having been moved to approximate the second molars, the second premolars are next moved posteriorly by adding two extension looped arms to the main buccolabial arch by soldering them to these arches in the cuspid area and each terminating in an attachment on the buccal surface of the second premolar bands. The resistance to the posterior movement of the second premolars, through adjustments by opening the loops of the accessory arms, is offered by the group anchorage as set up by the

combined resistance of all other teeth under the locking of the main arches which includes the first and second molars as well as all teeth anterior to the second premolars. The second premolars having been moved to approximate the first molars, the accessory arms are replaced to be applied to the first premolars in the same manner and to be moved by similar adjustments. The first premolars having been moved to approximate the second premolars, the cuspids are moved posteriorly by removing the accessory arms and employing the buccolabial arch and a traction ligature lingually from the eyelet on the lingual surface of the cuspid band to the loop of the lingual arch anterior to the first molar. The loop of the buccolabial arch is closed and the attachment locked.

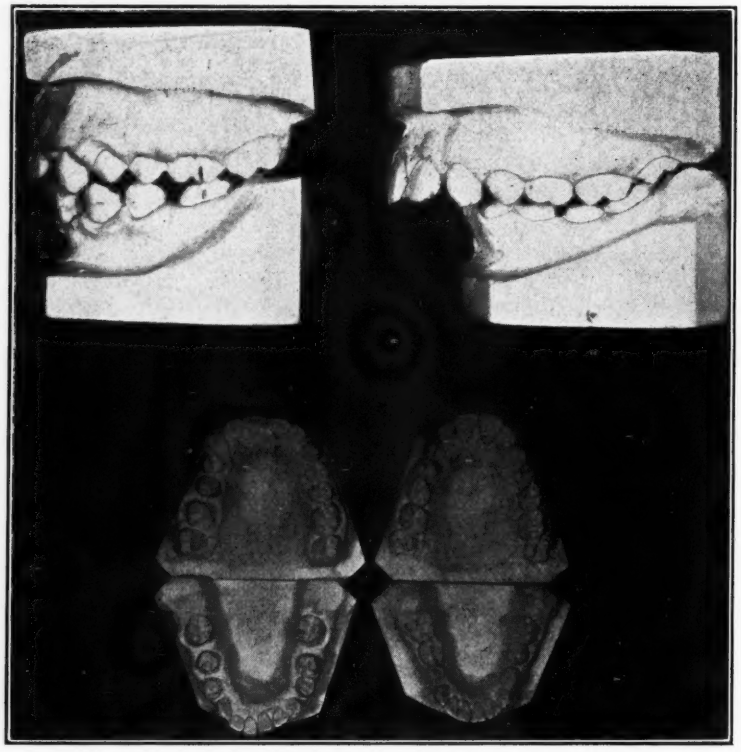


Fig. 63.—Case 16, case during treatment to show bodily tooth movements of maxillary teeth posteriorly and mandibular teeth anteriorly.

Thus, all teeth which have been moved posteriorly as well as the four incisors offer resistance to the movement of the cuspids posteriorly. The cuspids having been moved posteriorly, the four remaining anterior teeth are moved posteriorly by the combined pressure applied alternately to these teeth from the lingual and buccolabial arches. Ligatures are tied from the lingual arch, pressure is applied labially. All other teeth serve as resistance.

The movement of teeth, vertically, may be briefly explained by stating that the resilient arches are deflected buccolabially and lingually to engage elevation brackets or by tying tightly to the cervical wherein the reciprocal pressures elongate the teeth between the terminal areas of the arches, anteriorly and posteriorly, which offer resistance to pressure tending to depress them.

REFERENCES

Johnson, A. LeRoy: Basic Principles of Orthodontia, Dental Cosmos, April-Sept., 1923, 65, 397, 503, 596, 769, 845, 957.

Dewey, Martin: Constancy of Cusp Position as Related to Facial Forms, INT. J. ORTHO. 16: 180, 1930.

Angle, Edward H.: Malocclusion of Teeth, Seventh Edition.

Stanton, Frederick Lester: Critique of Simon's Diagnostic Methods, INT. J. ORTHO., January, 1928.

Idem: Arch Predetermination and a Method of Relating the Predetermined Arch to the Malocclusion to Show the Minimum Amount of Tooth Movement, INT. J. ORTHO., December, 1922.

Hellman, Milo: Variations and Anatomy of Jaw Bones, J. A. D. A., March, 1927.

Idem: A Preliminary Study in Development as It Affects the Human Face, Dental Cosmos, March, 1927.

Simon, Paul: Fundamental Principles of a Systematic Diagnosis of Dental Anomalies.

Krogman, Wilton Marion: Racial and Individual Variations in Certain Facio-dental Relationships, J. D. Res., August, 1934.

Griffin, Edward Mason: A Synopsis of the Correlation of Diagnostic Maps and the Technic of Resilient Arch Assemblage in the Teaching of Orthodontics, INT. J. ORTHO., October, 1932.

Idem: Construction and Manipulation of Orthodontic Assemblages With Special Reference to Rigidity, J. A. D. A., May, 1933.

Idem: The Technic of Resilient Arch Assemblage, INT. J. ORTHO., March, 1931.

Vogelson, Gabriel Roger: The Griffin Orthodontic Technic, Dental Cosmos, July, 1932.

Ferris, Henry C.: Proceedings of First International Orthodontic Congress.

Grieve, Clarence J.: Proceedings of Second International Orthodontic Congress.

Tildesley, Marion L.: Proceedings of Second International Congress, Appendix, Concerning Orthodontic Problems and Their Solutions, Brash's "The Etiology of Irregularity and Malocclusion of the Teeth."

Brash, Professor G. C.: The Etiology of Irregularity and Malocclusion of the Teeth, Dental Board of United Kingdom.

Idem: The Growth of the Jaws, Normal and Abnormal, in Health and Disease.

Lundström, A. F.: Malocclusion of the Teeth Regarded as a Problem in Connection With the Apical Base, Svensk Tandläkare Tidskrift, Stockholm, 1923.

Idem: A Contribution of the Discussion Concerning the Nature of Disto-Occlusion, Dental Cosmos, 956, 1925.

Idem: Proceedings of First International Congress.

Hoffman, Meyer: Surgical Resection for the Correction of Mandibular Anomaly, Proceedings of International Dental Congress, 1931.

115 EAST SIXTY-FIRST STREET

THE TECHNICAL PHASE OF ORTHODONTIC THERAPY

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ORTHODONTIC therapy consists chiefly in the correction of malpositions of the teeth and maldevelopment in the arches and jaws. It involves the reshaping of the bones of the maxilla and the mandible at the same time that the teeth are being induced to assume a position in harmony with the line of occlusion. This is possible through the fact that bone responds to all stresses and strains to which it is subjected and that its shape can be altered by subjecting it to different forces. These forces need not necessarily be applied directly to the bone but may be applied indirectly. In the jaws this is accomplished by applying the force to the teeth through which it is transmitted to the bone. The use of force of any kind is a problem in mechanics and is subject to its laws. This thesis is concerned with the principles of force, an examination of the problems in mechanics peculiar to the mouth, and a survey of the better known orthodontic appliances.

Force is usually produced by means of a machine. The simple machines as known in physics underlie all the more complicated types. They form the basis of orthodontic mechanisms or appliances and are used in these either in their simple forms or in a combination of several forms. Those simple machines which are directly related to our problems are the lever, the plane, and the screw.

The lever is a type of machine in which a bar is supported in its length at some point called the fulcrum. At some other point in its length a force is applied which is transferred to a third point in the length of the bar with the object of overcoming the resistance at this latter point. There are three classes of levers. In a lever of the first class the fulcrum is located at some point between the force applied and the resistance to be overcome. In a lever of the second class the force applied and the resistance are on one side of the fulcrum which is at one end of the bar. The resistance to be overcome is in this case located nearer the fulcrum than the applied force. When the fulcrum is at one end of the bar and the force applied is nearer it than the resistance, we have a lever of the third class. A lever of the first class is used where the force applied is greater than the resistance; that of the second class where the resistance is greater than the force; and that of the third class where it is desired to move the resistance through a great distance.

The inclined plane is a type of machine in which a body may be drawn up an inclined surface and hence raised to a height by a force which is less than the weight of the body. The direction in which the body can move is directly controlled by the angle of inclination of the plane surface.

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The screw, or, as more commonly known, the jackscrew, is a machine in which a threaded bar rotates in a nut. The thread of the bar is at a constant angle with the length of the bar. If the thread were opened up, it would form an inclined line. The nut is fixed, and the force is transmitted through the bar.

In addition, there is a property of matter known as elasticity. When a mass possessing the property of elasticity is altered in shape or volume by some force, it tends to return to its original form or shape, thereby exerting a force in the opposite direction. This is a very useful property and has been taken advantage of in the mechanics of orthodontic therapy mostly in the form of intermaxillary elastics.

The problems of mechanics are altered somewhat in the mouth because of the anatomic features of the structures involved. The teeth present convex smooth surfaces to which it is difficult to apply a force and be certain of its action over a period of time; hence a means of attachment to the teeth must be devised. There is no definite fixed point in the mouth from which a force can be applied without the reaction producing some effect on that point. The teeth are not rigidly fixed in the jaws. They are attached to their bony sockets by means of a membrane which allows a slight amount of movement during the act of mastication. Bone itself is a type of tissue that responds readily to all stresses and strains to which it is subjected. Hence, when a force is applied from one point in the dental arch, this anchorage is itself subject to the reaction of the force. If the force is greater than what the anchorage will stand, the tooth or teeth from which the force is applied will move. Hence anchorage in the mouth presents a very definite problem. It must be very carefully planned when contemplating the use of any force whatsoever in the mouth.

The teeth in each jaw are arranged in the form of a curve, hence the term, dental arch. Forces must often be exerted around the curvature of this arch, and these forces must be carefully resolved in order that the reacting force may be ascertained and allowance made for this in the anchorage.

The patient cannot be under the operator's care continuously but must be dismissed for intervals; therefore the machines or appliances must be devised to exert force during the time that the patient is not directly under the operator's eye.

Finally, the stresses during mastication must be considered. The force exerted by the muscles of mastication on the jaws is considerable. This force is transmitted to the bolus of food which is itself forced along the surfaces of the teeth. Any foreign object on such surfaces is subjected to the stress exerted by the food. Unless it is of sufficient strength or so attached to the teeth that it will resist these stresses, it is liable to be distorted. When distorted its effect may be quite adverse and injurious.

In orthodontic therapy force in the mouth is delivered by mechanisms or force-producing machines called appliances. These are connected to the teeth by means of bands which are accurately fitted and cemented to the teeth. These bands give a firm grip on the teeth. Previous to cementation some form of attachment such as a tube of some kind is soldered to the band. This attachment acts as the connecting link between the appliance and the band, providing the

necessary anchorage and enabling the machine to work. The rigidity of the connection depends on the nature of the attachment on the band and the accuracy with which the appliance fits it.

Ever since teeth have been moved, various mechanisms have been used for exercising the necessary force or stimulus. The evolution of such appliances has been a continual stream of progress. Appliances have been in use for some time and then discarded, new ones taking their place. Various types are in use at the present time, each possessing some special feature of its own. Before analyzing these it would be advisable to inquire into the properties which the peculiar nature of conditions in the mouth demand that an appliance should possess before it can be acceptable. These are efficiency, physiologic action, simplicity, strength, stability, delicacy, cleanliness, and inconspicuousness.

To be of any use at all an orthodontic appliance must be efficient. It must be able to exert the necessary forces and guide the teeth into the desired position; otherwise it cannot be considered. No matter how attractive an appliance may be from other points of view, it must answer this first demand made upon it. The extent of its efficiency may not be 100 per cent, and the deficiency may be offset by other qualities; but, at least, it must have the possibility of carrying out the desired tooth movement.

In its action the appliance must be physiologic. Its power should be entirely within the control of the operator. It should permit of very fine adjustments so that the degree of force may be increased or decreased by any desired amount. The force itself should be gentle and should stimulate the process of resorption and deposition of bone. The degree of force applied should not expend itself immediately but gradually so that there may be no injury to the periodontal membrane.

An appliance should be as simple as possible in its construction and in its application. If it is complicated in its construction, it may be beyond the ability of many operators and the difficulties involved may result in an unsatisfactory and poor mechanism. A complicated appliance is difficult to handle in the mouth. It presents a considerable problem in the resolution of its forces, and consequently there may result unexpected and undesired reactions.

Strength is another requirement that an appliance should fulfill. This means that the materials or alloys of which the appliance is constructed should be such as to withstand the tendency toward breakage resulting from manipulation or from the force of mastication and occlusion. The nature of the material should be such that great bulk is not required for strength.

Stability is another important attribute. The appliance should be able to withstand the stress of mastication sufficiently to prevent dislodgment. If it becomes distorted or dislodged, it may impinge on the soft tissues and cause a certain amount of trauma, or it may exert an adverse force in a direction quite undesirable.

The appliance should be a delicate one. Only through a delicate mechanism can gentle forces be exerted, and the less cumbersome it is, the more readily will it be tolerated by the oral soft tissues and by the patient. Orthodontic treatment usually extends over a considerable period of time, and a delicate mechanism is necessary in order that the patient be taxed as little as possible.

Another important feature of an appliance is the possibility of keeping it clean. At best any foreign object on the teeth acts as a center for accumulation of food. The appliance should be so constructed that food particles cling to it as little as possible and those adhering can be easily removed by the toothbrush. A mechanism that lodges food remnants against the enamel surfaces and interferes with their ready removal is a menace to the health of the teeth, and its prolonged use is questionable.

The last factor to be considered is that of inconspicuousness. An appliance should be as inconspicuous as possible without sacrificing any of the previous qualities. Esthetic appearance can be obtained by the choice of metal for the device, by the location on the tooth at which the mechanism is placed, and by the fineness of its construction. With some patients, especially of the older type, the inconspicuousness of the appliance plays a very important rôle and may be the deciding factor as to whether they will submit to the necessary treatment.

All orthodontic appliances are of two types. Appliances of the first type are completely under the control of the operator. They can be removed only by the operator, the desired adjustments made and then replaced by him. This type is usually designated as fixed appliances. The other type is only partially controlled by the operator. The adjustments, of course, are made by him, but the removal and the insertion of the appliance can be and is done by the patient. In fact, the appliance can be removed at any time. This type is usually termed removable appliances. There are advantages and disadvantages to each type.

The removable type of mechanism has one decided advantage. It can be removed after meals, and both it and the teeth thoroughly cleaned, thus enhancing the quality of cleanliness. This property of easy removal, however, may become a very undesirable feature in the hands of some patients. The tendency to remove the appliance on the slightest provocation becomes a habit with the result that very little progress in treatment is achieved. The experience of most operators is that very few patients can be relied upon to wear a removable appliance consistently. The removable type of appliance is seen in the Jackson appliance and in bite-plates and retaining appliances of the Hawley type.

Because of the unreliability of most young patients the fixed appliances are the ones most commonly in use. Their greatest advantage lies in the fact that they are strictly controlled by the operator. The patient cannot remove the appliance, and hence his cooperation in this respect is obviated. The continued action of the appliance depends entirely on its construction and its operation. On the other hand, this type of appliance cannot be kept clean so easily by the patient, and even if well and finely constructed it still depends on the operator for thorough hygiene of the teeth. Nevertheless, its efficiency compensates for this. Its cleanliness may be enhanced somewhat by simplicity in design, fineness of materials used, and care and attention both by patient and by operator.

The term fixed appliances really comprises two groups. In one, the entire appliance including bands and wires is one complete unit, being soldered together and set in the mouth by cementing the whole unit on the teeth. Adjustments are made directly in the mouth. The lingual arch of this type is perhaps

the most familiar one, and its action is obtained by the stretching of the base or arch wire by means of special wire-stretching pliers. The resolution of force becomes a difficult matter here, and there is grave possibility of undesirable movements occurring in the anchor teeth. Again, any desired alterations in the appliance can be obtained only by the removal of the entire unit and its consequent recementation. This involves a good deal of time and effort and hence is undesirable if it can be avoided. As a consequence, this type of appliance is not found in great use. Its chief feature is that there is no loss of efficiency through connections between parts.

The other type of fixed appliance might possibly be called "fixed removable." It is removable by the operator, and it is fixed as far as the patient is concerned. The active part of the appliance, usually termed arch wire or base wire, is attached to bands which are cemented on the anchor teeth. The means of attachment between the tooth and the arch wire consists of some type of tube soldered to the band and a part at each extremity of the base wire which fits this tube. The security of attachment is dependent on the accuracy with which these parts fit one another. When the appliance is removed from the mouth, both the mouth and the appliance can be thoroughly cleaned. Any necessary adjustment, alteration, or addition can then be made to the arch wire before it is reinserted. This allows considerable flexibility in its use and accounts for its preference over the type previously considered.

The fixed-removable appliances may be subdivided into two divisions depending on their location in the mouth. One includes all those appliances in which the arch wire lies along the labial and buccal surfaces of the teeth; these are termed labial appliances. The other subdivision includes all those appliances which lie along the lingual surfaces of the teeth; these are termed lingual appliances.

Many varieties of labial appliances have been introduced and are still in use. They vary from the quite simple and easily manipulated ones to those which are quite intricate and difficult to handle. Classed as a whole they are efficient, physiologic, varying in their simplicity, strong but varying in their stability. Their delicacy varies as does the property of cleanliness. With the exception of the high labial arch, labial appliances are conspicuous.

The simplest type of labial appliance is the plain expansion arch. It consists of a round wire of heavy gauge (0.038-0.045) adapted to the general arch form of the teeth and inserted into horizontal round tubes (of the same internal gauge as the wire) soldered to the buccal surfaces of the anchor bands. It is attached to the other teeth by means of silk or wire ligatures. As originally introduced by Angle the ends of the arch wire were threaded and had a similarly threaded nut and friction sleeve at each end. Angle also advocated placing bands on all teeth to which ligatures were to be applied. In this form the appliance combined the principles of the jackscrew, the spring and the contractibility of moistened silk.

The great advantage of this appliance is its simplicity both in construction and in operation. It is efficient for the simple movements of teeth. It is inefficient for bodily movement of teeth or for root movement. If bands with lingual spurs are cemented on the teeth and the arch is ligated to the teeth, it

is stable and strong. It is, of course, not delicate. It can be kept fairly clean, and as the arch and ligatures rest on the bands the accumulated food débris does not injure the teeth. Nevertheless, the ligatures are a great disadvantage, for they are liable to injure the soft tissues, prevent the close proximal contact of the teeth, require time for their application, and often work loose under stress. In addition, the spurs on the lingual surfaces of the anterior bands often interfere with the occlusion, especially in those cases in which an excessive overbite is present.

This type of appliance is often used in a modified form. Instead of the ends of the wire being threaded, they are plain and the nuts are eliminated. The action of the nuts is replaced either by stops soldered on the arch wire in contact with the mesial end of the anchor tubes or by loop springs soldered mesial to the tubes. There is also a tendency to use this appliance with bands on the anchor teeth only, the ligatures being applied directly to the teeth or with no ligatures at all. Used in this way the stability of the appliance is decreased with a possibility of anchorage displacement especially where intermaxillary elastics are employed. The application of the arch wire or the ligatures directly to the surfaces of the teeth is fraught with danger to the enamel.

In order to eliminate the undesirable feature of ligatures in the interproximal embrasures and of lingual spurs, McCoy has devised an attachment called the McCoy open tube. It is a horizontal tube with part of the wall cut away so that the arch can be slipped in between the two open flanges instead of being slipped through a complete tube. At each end of the tube is an extension or arm. These tubes can be used on all teeth except anchor teeth. Bands are made for the teeth and the tubes soldered horizontally on the labial or buccal surfaces. A round wire arch is used with corresponding horizontal round tubes for anchorage attachment. It is really a simple expansion arch without the ligatures. Rotation is accomplished by ligating the arms to the arch wire. Root movement may be obtained by soldering fine wire extensions vertical to the base wire. The attachment is made of spring metal which permits the flanges to be sprung open or closed and so hold the arch in place. This appliance can be used particularly effectively when the maxillary anterior teeth are in protrusion and are spaced. It overcomes the objectionable features of the simple expansion arch. On the other hand, it is not so simple in its manipulation. The tubes must be properly aligned in the same plane occlusogingivally or there may result slight extrusions of individual teeth. Unless carefully aligned the flanges of the tubes occasionally interfere with the final movements of individual teeth that are badly malposed.

Dr. A. H. Ketcham devised the Ketcham attachment to be used with the simple expansion arch and with the same end in view as the McCoy attachment. It consists of a wire shaped like the letter H with one vertical stroke removed and the horizontal arm placed nearer the upper end of the other vertical stroke. The end of the horizontal arm is soldered to the labial or buccal surface of the band, the direction of the attachment being parallel to the long axis of the tooth. The arch wire is slipped under the lower arm and held in place by means of a fine wire ligature attached to the upper arm. For rotation a small eyelet is soldered to the band to the mesial or distal of the attachment as the condition

may require. Root movement is obtained in the same way as with the McCoy attachment. It offers the same advantages and presents the same difficulties as the previous mechanism.

The high labial arch is another type of labial appliance. It was devised by Lourie. It consists of a round base wire adapted to the alveolar arch above the necks of the teeth. In the region of the first bicuspids the arch is bent toward the occlusal and then horizontally across the buccal surfaces of the bicuspids to be inserted in horizontal tubes soldered to the anchor bands. Opposite the teeth to be moved fine wires are soldered perpendicular to the arch wire. By means of these fine extensions force is delivered for the desired tooth movement. Anchor bands only are as a rule necessary. The appliance is held in place by ligating the arch to the anchor tube or by a soldered loop spring catching behind this tube. Occasionally it is necessary to use a band with some type of attachment for the rotation of teeth, especially the bicuspids. The particular feature of this appliance is its inconspicuousness. The arch wire is not visible. The only parts that are visible are the finger spring extensions, and being usually of 0.020 or 0.022 diameter they are not conspicuous. The appliance is delicate and lends itself toward cleanliness. It is not stable. It is particularly suitable in cases of protrusion of the maxillary incisors where there is very little rotation. It is not efficient for expansion of the lateral halves of the arch and for this purpose requires the assistance of a lingual appliance. The principle behind this appliance is the spring.

In order to facilitate root movement and bodily movement of teeth Angle devised the round pin and tube appliance. The original attachment to the anchor bands was a horizontal round tube which did not prove satisfactory and was replaced with a half-round vertical tube by Young. The attachment to the other bands was a round tube soldered parallel to the long axis of the tooth. Grieve further modified the appliance by using a half-round tube for all bands. In the half-round pin and tube appliance bands are necessary for all the teeth to be moved. Large half-round tubes are soldered on the buccal surfaces of the anchor bands parallel to the long axis of the teeth. Small half-round tubes are soldered to the labial or buccal surfaces of all the other bands also parallel to the long axis of the teeth. All bands are cemented on the respective teeth. An arch wire of spring metal of 0.028 or 0.025 diameter is annealed and then adjusted around the arch and a half-round pin soldered opposite each tube. It is preferable to have a U-shaped loop between every two pins. The arch wire is adjusted so that every pin rests in its tube without exerting any force whatsoever in any direction. To avoid too rigid an attachment the flat surfaces of the pins may be ground slightly. The temper of the appliance may then be restored, and the appliance is held in place by the use of several types of wire locks.

The half-round pin and tube appliance is very efficient and stable. It offers absolute control over the individual movement of teeth by opening or closing the loops and permits of all types of tooth movement. It is not inconspicuous, but if the bands are adapted high up on the tooth close to the gingival margin and the appliance is neatly constructed it is not unsightly. It is hygienic inasmuch as the surfaces of the teeth are protected by the bands and accumulation of food can occur only on the bands. Its action is based on the

spring. It is not particularly adapted for closing the spaces between the maxillary anterior teeth in cases of a fanlike protrusion of these teeth. Neither is it the most satisfactory appliance in cases of open-bite. It requires care in its construction and manipulation but does allow for an easy check on the latter.

The ribbon arch mechanism and the edgewise mechanism may be considered together for they are alike in many ways. They were both devised by Angle. The former was introduced a number of years ago, while the latter was presented to the profession within the last few years. In both cases there are special attachments already soldered to the band material before the band is made. They require bands on all the teeth. The attachment to the anchor bands is by means of a horizontal tube with a rectangular or square lumen. The bands are fitted to the middle third of the tooth. In the case of the ribbon arch the arch wire is rectangular (0.022 x 0.028) and is accurately received by the attachments on the bands from the incisal and locked into place by a soft wire post. The arch wire in the edgewise mechanism is a square wire (0.022) and fits the U-shaped brackets or attachments accurately, being held in place by means of fine wire ligatures. The attachment between the arch wire and the tooth is a rigid one.

Both these appliances lend themselves to all movements, particularly mass movements of teeth. They are specially suitable in cases of deep overbite. Rotations of individual teeth are obtained by soldering eyelets to the bands and ligating these to the arch.

These appliances are efficient ones, and their stability is ensured by the number of bands used. The arch wire is delicate, but this is offset by the accurate fit between the wire and the bracket with a consequent rigidity of attachment. The appliance is not inconspicuous, as it is placed in the middle third of the crown. The hygienic qualities are about the same as those of the pin and tube appliance. The action is based on the spring, the lever, and the jackscrew.

The edgewise mechanism is an advance over the ribbon arch, being much more flexible in its use. It permits the movements of posterior teeth distally en masse which has not been possible with previous appliances. It requires a great deal of care in its construction and in its manipulation, and the check on this is not easy because of the small size of the brackets. Ligating it into place consumes some time.

The fixed removable type of lingual arch is one very commonly used and for very good reasons. It was originally devised by Mershon and further developed by Oliver. It consists of two anchor bands, to the lingual surfaces of which are soldered some form of attachment, usually half-round vertical tubes. A round wire of 0.038 diameter is adjusted along the lingual surfaces of the teeth with half-round posts soldered to it at points corresponding to the position of the tubes. Fine wire finger springs of various types may then be soldered at different points on this base wire to exert force on whatever tooth and in whatever direction desired. A lighter base wire of 0.033 diameter may be used instead and U-shaped loops bent in it just mesial to the tubes. By opening the loops the base wire itself may be used to exert the necessary force.

The principle activating the force in the lingual appliance is that of the spring. It is a very efficient appliance in certain cases and is particularly suitable for the mandibular arch in Class I and Class II cases. Its great features are that it is inconspicuous and easily kept clean. It is not very stable and is subject to breakage at the junction of the half-round post with the base wire from manipulation by the tongue. This can be overcome by placing bands on the lateral incisors or cuspids with spurs soldered on the lingual. The appliance is a simple one and is not difficult to construct and manipulate. The fine finger springs are subject to distortion from the forces of mastication, and careful planning is required in their construction to avoid this as much as possible. Rotations are difficult to obtain and usually require bands with spurs and ligatures.

In conclusion it can be seen that no one appliance entirely fulfills all requirements or can be used in all conditions of malocclusion. Rather, the operator must choose that appliance which best suits the condition he is attempting to treat and which at the same time brings satisfactory results in his hands.

REFERENCES

Angle, Edward H.: Treatment of Malocclusion of the Teeth, Philadelphia, ed. 7, 1907, S. S. White.

Dewey, Martin: Practical Orthodontia, St. Louis, ed. 4, 1919, The C. V. Mosby Co.

Ford, J. W.: High Labial Arch Technic and Some Results, INT. J. ORTH. **14**: 699, 1928.

Idem: High Labial Arch, INT. J. ORTH. **17**: 887, 1931.

Grieve, Geo. W.: The Half-Round Pin Appliance, With Auxiliary Springs and Individual Bite Planes, Dental Cosmos **64**: 6, 601, 1922.

Hyams, Bernard L.: The Application of Force as a Therapeutic Measure for the Correction of Malocclusions, INT. J. ORTH. **14**: 584, 1928.

Jackson, V. H.: The Principles of the Jackson Removable Appliance, INT. J. ORTH. **7**: 175, 1921.

Ketcham, A. H.: Case Indications for the Use of Some of the More Efficient Forms of Appliances, INT. J. ORTH. **10**: 677, 1924.

Lourie, Lloyd S.: Some Forms of Spring Extensions for High Labial Arch, INT. J. ORTH. **16**: 748, 1930.

Mershon, John V.: The Removable Lingual Arch Appliance, Tr. First Internat. Orth. Congress, St. Louis, 1927, The C. V. Mosby Co.

McCoy, James D.: Applied Orthodontia, Philadelphia, 1922, Lea & Febiger.

Idem: A New Application of an Old Principle in Orthodontic Mechanism, INT. J. ORTH. **11**: 493, 1925.

Idem: Essential Technic in the Use of the Open Tube Appliance, Tr. First Internat. Orth. Congress, St. Louis, 1927, The C. V. Mosby Co.

Oliver, O. A.: The Technic of the Lingual and Labial Arches, INT. J. ORTH. **15**: 527, 1929.

Idem and Wood, C. R.: Principles Involved in the Lingual and Labial Arch With Auxiliary Spring Attachments, INT. J. ORTH. **18**: 478, 1932.

Strang, R. H. W.: A Textbook of Orthodontia, Philadelphia, 1933, Lea & Febiger.

Waldron, Ralph: The Selection of Appliances in the Treatment of Malocclusion, INT. J. ORTH. **12**: 403, 1926.

Idem: The Dynamics of the New Angle Mechanism, as Observed by a Non-Angle Man, INT. J. ORTH. **17**: 1113, 1931.

Young, J. Lowe: Evolution, Construction and Manipulation of the Pin and Tube Appliance, INT. J. ORTH. **12**: 981, 1926.

BASIC PRINCIPLES APPLICABLE TO CERTAIN MANIPULATIONS OF THE EDGEWISE ARCH MECHANISM

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THE principle of the ideal arch form is one of the most important and helpful virtues associated with the application of the edgewise arch mechanism. It acts as the pattern with which the form of the denture must harmonize in all three planes when treatment is completed. Thereon is located a definite position for each individual tooth. Consequently, the objective in treatment is definitely limited to two fundamental problems: first, the moving of each tooth to its correct and planned position on its respective arch wire; and, second, the moving and locating of each arch wire pattern to a position that is judged to be correct in the anatomic plan of the individual under treatment. In other words, placing the maxillary and mandibular arch wires in proper relationship with skull anatomy which coincidentally carries them in proper adjustment with each other.

Consequently, it is most essential that the size of the arch wire be such that thereon can be found room for every dental unit and that the form of the wire pattern be such that when these dental units are assembled correctly, the composite dental arch, thereby evolved, be of normal shape and contour.

The first demand is quite readily solved by tooth measurement which is carried out for each individual case and the length of the arch wire material cut accordingly. The location for each tooth is likewise designated from these measurements, due allowance being made for the space that will be taken up by band material and by the necessary curved modifications that enter into the adjustments made to effect the correct arch form.

The outline form of the arch wire pattern has received considerable analysis and has been perfected to a marked degree over that which was originally suggested when this mechanism was introduced. In the evolvement of the pattern form that is now used, the work of Drs. Steiner, Lashar, Chuck and Furby of California must be given full credit. I have contributed certain technical steps whereby the arch wires are readily made to harmonize with the basic pattern adopted by these men as most nearly correct for the majority of dentures.

The greatest change in the ideal arch wire pattern from that originally suggested is seen in the mandibular arch. The maxillary arch wire closely resembles the one primarily adopted.

In casting about for some tangible pattern upon which to base the form of dentures, the above mentioned orthodontists found that Bonwill's old principle of the equilateral triangle adapted to orthodontia by Charles Hawley came nearest to meeting the standard exemplified by nature in all dentures that could be found in which normal occlusion had evolved without mechanical interference. It also held true in cases which they had treated with success and that

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looked most natural. Consequently, they chose this predetermined pattern as their tangible foundation for shaping the edgewise arch wire, notwithstanding that by so doing they must eliminate the personal judgment, for the time being, at least, of what the particular type of the patient required in arch form. Attention should also be called to the fact that Ralph Waldron suggested the use of this pattern in a paper published in the INTERNATIONAL JOURNAL OF ORTHODONTIA, December, 1931.

Their problem, however, was not solved alone by the selection of the principle of the Bonwill-Hawley chart. This, you will recall, gave an arch form that was harmonious with the occlusal edges of the incisors and the tips of the buccal cusps of premolars and molars. The ideal arch wire of the edgewise arch appliance does not lie in this region, but is placed in the center of the labial surfaces of the incisors and canines and the buccal surfaces of the premolars and molars from which it is separated just the thickness of the bracket floor. Adjusting soft metal arch wires to these surfaces of teeth in normal occlusion and comparing their variations with the form of the Bonwill-Hawley drawings gave these orthodontists the data needed, and the technical modifications were incorporated into a procedure for ideal arch wire formation that is very definite, accurate, and most satisfactory in effecting results in treatment. (This technic can be found in the *Angle Orthodontist,* Vol. VI, No. 2, under Case Reports.)

I became enthusiastic over this method from a teaching standpoint, but tested it thoroughly in clinical application before giving it to students. I can report most favorably upon its clinical tests, for I have never obtained results in denture form that appeared as harmonious to the patient's features as have those effected through adhering to a pattern form based upon this technic.

It is now quite evident to me that variation in denture form because of type is never of great degree; and if we can produce dentures of such harmonious outlines as those that result from the use of ideal arch wire forms made according to the technic now practiced, Nature can readily do the typal readjusting for us as she balances the environmental forces that play over these biomechanically evolved dentures. The comforting advantage of always being able to turn to a definite pattern for comparison and reshaping of the powerplant that is our active and energizing guide is a factor of inestimable value. I can recommend its use with earnest and honest conviction.

So many of the cases of malocclusion that come to us these days require a posterior shifting of teeth, either singly or in groups, that it is exceedingly important that the orthodontist know the proper appliance manipulations with which to effect such changes and which one of these technical procedures to choose under the requirements of treatment. Certainly the operator who has not at his command some means of moving teeth distally is sadly handicapped and is bound to effect results in many of his cases that give a toothy appearance or that exhibit perverted axial inclinations which functional forces cannot overcome to a passable degree. This defect in therapeutic equipment has led to far too much compromise treatment in the form of surgical interference with the sacrificing of precious dental units. To me, such a procedure, even in cases of exaggerated malocclusion, is a sacrifice of ideals that should be shunned by all conscientious operators.

In reviewing the cases treated in the past thirty years, I find that I have sacrificed teeth in but three patients and that there are three other cases that would have been better off if I had compromised my ideals. Thus you will note that in about every five years of practice a case has appeared in which the deformity was so exaggerated and the causes were so powerful and uncontrollable that better results seemed probable if teeth were removed. Certainly this represents a very low percentage in the total of cases treated with reasonable degree of success by adhering to the highest of ideals.

Where would the specialty of orthodontia have been today if men prominent in its history had not persistently and belligerently fought for the integrity of the denture and evaluated success only in terms of that beautiful example of Nature's normal occlusion of the teeth?

ADJUSTMENTS FOR DISTAL TOOTH MOVEMENTS

Consequently, it seems to me that there is a great demand for distal movement of teeth, for only by such form of treatment can certain of these complicated deformities be corrected without effecting an unsightly end-result.

With the edgewise arch mechanism there are three technical procedures that are preeminently successful in effecting such a tooth movement. These are the so-called tip back bends, the horizontal loop principle, and the vertical spring loop auxiliary. Each has a definite indication for its use.

The tip back bends are chosen when the entire denture, incisors, canines, premolars and molars, requires distal shifting. A typical case would be the maxillary denture in a Class II, Division 1 malocclusion. In this type of case the tip back bends, incorporated in the buccal segments of the denture and reinforced by the power of intermaxillary elastics which are absolutely essential adjuncts, tip the crowns of the buccal teeth distally and the crowns of the incisor teeth lingually. Coincidentally, they cause a depression of the anterior teeth, a movement that is also indicated in this form of malocclusion in order to overcome the overbite. After the crowns have been carried back *beyond* the point desired, the roots may be driven distally as a secondary procedure by slowly removing the tip back bends while continuing the elastic force action.

The second principle that may be applied is that of the action of the so-called horizontal loop. This activation of the arch wire in a local segment is so termed because in setting the mechanism in action that portion of the arch wire that stores up the power is bowed out in the form of a loop that lies in the horizontal plane or in the same plane as the occlusal surfaces of the teeth are located.

It is indicated when the operator desires to open a slightly constricted localized area in the denture or to increase the length of the denture anteroposteriorly to a small degree by a distal movement of some of the teeth and a forward movement of certain others. The degree of distal movement over the anterior movement can be controlled to a great extent by intermaxillary elastic force. The horizontal loop principle is much more effective with a light, round arch wire than with the edgewise arch wire; hence the anchorage in the anterior segment of the denture is not a stationary one, and the distal movement cannot be as positive as with an auxiliary which is added to the edgewise arch

wire, such as the vertical spring loop. It is for this reason that we use it when we wish a combined distal and forward movement of denture units originating at a local point and disseminated therefrom in both directions.

The third principle is the one that I have found most effective in producing a distal movement of the buccal segments of the denture without disturbing the anteroposterior position of the anterior teeth. This is the vertical spring loop auxiliary, with which I think most of you are familiar.

In the use of this principle we must always remember that it is the most dangerous of all of the auxiliaries of the edgewise arch wire because of the multiple directions of force dissemination that associate themselves with any modification that is made in the form of this vertical loop. Consequently, there are certain basic principles that must be observed when we employ this device. These may be tabulated as follows:

(a) We must adhere rigidly to the principle of the ideal typal arch wire. This means that the first step in the preparation for the application of this force is the formation of the ideal typal arch wire, as usual.

(b) We must insert this spring force in the typal arch wire in such a manner that the principle of the ideal is still preserved. This is done by soldering a small, harmonious, delicate vertical loop, not more than $\frac{5}{32}$ inch in height and $\frac{1}{8}$ inch between its arms of attachment, in the correct location without destroying the continuity of the arch wire. Following this step, the arch wire is cut between the loop legs with a knife disk which still assures the preservation of the sacredness of the ideal typal arch form and pattern. We use a vertical loop because the continuity of arch wire surfaces demands it and a horizontal loop would injure the tissues.

(c) In order to overcome the diversion of forces that emanate from the point of compression or expansion of a vertical loop inserted on an arch wire, and so limit its action to anterior and posterior thrust forces, there must be *correct principles of anchorage* associated with the adjustment of the mechanism in the mouth. The horizontal form of bracket slot, accurately engaging the rectangular arch wire at points closely related to the loop, furnishes the control that is needed. Therefore it is necessary first to perform such tooth movements as are required to obtain bracket seating of those teeth that must be used for anchorage before the loop is attached to the arch wire. When such anchorage is gained, the force emanating from loop compression or extension will be limited to an anteroposterior thrust or pull and becomes just as positive, definite, physiologic, and helpful as the torque force.

(d) The vertical loop must reproduce or reestablish the concept of the ideal arch wire when it is static; hence it must be set in action by being compressed or distended by *ligature traction and not by loop bending.* The correct effect of ligature traction is dependent upon and governed by ligature and stop spurs or staples placed at advantageous points in relation to properly selected brackets on either side of the loop or from points of anchorage correctly related to the buccal sheath. If this principle of power production is observed, the tooth movement resulting from the activity of the vertical spring loop is effected in a positive and direct manner, *with perfect force control.*

If ligature spurs are placed on the arch wire in such relationship to selected brackets upon teeth on either side of the loop that traction by ligatures will pull these spurs toward the loop area, the vertical spring loop will be contracted by this ligature traction, and the teeth under the influence of the power thus evolved will tend to move away from the point of loop insertion. On the other hand, if ligature spurs are placed in such relationship to brackets on teeth on either side of the spring loop that traction on the ligatures tends to pull these spurs away from the loop area, the loop will be expanded by the ligature traction, and the teeth under the influence of the arch wire in this area will tend to move toward the point of loop location.

The vertical spring loop is almost always set in action by the traction of a ligature that is *distally* located thereto. Ligatures that are mesially placed to the loop are usually only sources of anchorage support.

(e) The vertical spring loop should preferably be inserted in those sections of the alignment arch where the opposing forces, emanating from the expansion or contraction of this auxiliary, by ligature traction, will dispense themselves along lines that are continuous or parallel with one another. When this is not practicable, such a location should be chosen as will avoid any marked divergence of the lines of force from the ideal planes. Suitable anchorage must then be provided whereby the faulty tendencies can be properly controlled.

The most dangerous and therefore the most prohibitive area for the vertical spring loop to occupy is the canine region of the arch wire, for here it is that the anterior and buccal planes of the denture meet, and hence forces passing from the two sides of a loop so located would diverge at marked angles and so would be exceedingly difficult accurately to gauge and control.

When the loop is contracted by a ligature, anterior and posterior thrust forces are set in action, but these will not be equally distributed on the crowns and the roots of the teeth. There will be more force acting on the tooth roots than on their crowns because of the tendency of the arch wire sections, mesially and distally to the loop, to leave the horizontal plane. In other words, there is a similar effect to that produced by mesial and distal tipping bends to which have been added a horizontal thrust force, but the primary action is on the tooth roots instead of on their crowns.

Therefore the first movement that occurs in the teeth attached to the arch wire, when the loop is contracted, is a shifting of the *root apices* in a direction away from the loop. Gradually the movement is taken up in the crown section of the teeth until, toward the end of the change, the crowns catch up to the roots and the teeth assume the same vertical positions that they were in when the action of the vertical spring began.

This exaggerated action upon the roots of the teeth is present not only in the buccal segment of the denture, where the vertical spring loop is usually located, but also in the incisor region. When the loop is contracted, the direction of action upon the incisor roots, however, is not mesial or distal, as in the premolar and molar area, but labial. It is just the same as if a lingual torquing twist had been introduced into the anterior segment of the arch wire. This duplicates, during the primary stages of loop action, the effect of

stationary anchorage in the incisor region and tends to cause the buccal teeth to move distally more readily and to a greater degree than the incisors move labially.

Those who are not familiar with the edgewise arch mechanism are strongly advised to place it upon a technic model of similar form to those used in the clinic today and practice the various tooth movements on this model. By such means one can train oneself to adjust and manipulate the mechanism intelligently, purposefully, and safely. One can then apply the appliance to the mouth with a reasonable degree of certainty of success. To place the edgewise arch appliance in the mouth without first familiarizing oneself with its accurate technical requirements is a most primitive and unwise thing to do. An operator must know and not guess when using an appliance that is as positive and efficient as is this one, for teeth are bound to move when it is adjusted to them, and such movement must be intelligently controlled.

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REPORT OF TWO OPEN-BITE CASES

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THE two cases which I wish to present are both of the so-called open-bite type. My object in presenting them together is to illustrate two conditions which at first glance appear to be similar but which differ widely in their history, etiology, prognosis, and treatment.

CASE 1.—The first case was of a boy eight years old who presented the malocclusion as seen in Fig. 1.

History.—The only notable feature in the history of an otherwise normal child was a delayed eruption of the permanent incisors following the somewhat early loss of the deciduous incisors.

Fig. 1.

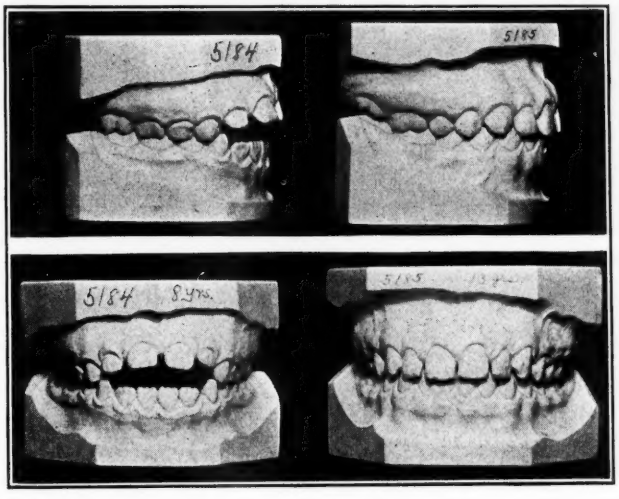

Fig. 2.

Etiology.—The space thus formed allows the tongue to slide forward during talking and swallowing and constitutes a mechanical interference to the erupting incisors. This establishes a vicious circle of habit and malocclusion. (Fig. 2.)

Diagnosis.—You will notice that the posterior teeth are in neutroclusion and that an infraclusion exists in both the maxillary and the mandibular incisors. There is also some protrusion of the maxillary incisors.

Prognosis.—The prognosis for the permanent correction of a malocclusion of this type depends solely upon our ability to establish and maintain the normal function of the tongue. However, since the converse is also true, the problem is to attack the circle of cause and effect at some strategic point. It is vital that diagnosis and treatment be made early if prognosis is to be favorable.

Read before the New York Society of Orthodontists, New York, March 24, 1936. By permission of the American Board of Orthodontia.

Treatment.—Bands, carrying plain 19 gauge tubes, were cemented to the deciduous molars, and a high labial wire with fingers to the central and lateral incisors was applied. When this appliance had been in operation for several weeks, a short lingual wire was applied with short spurs to keep the tongue from assuming its abnormal position. The patient was instructed in the correct use of his tongue during speaking and swallowing.

Exercises were also prescribed to increase the tone of orbicularis oris and masseter-temporal. No vertical force was applied and no appliance adjusted to the mandible. This case has been corrected for two years with no reversion and with function normal.

Fig. 3.

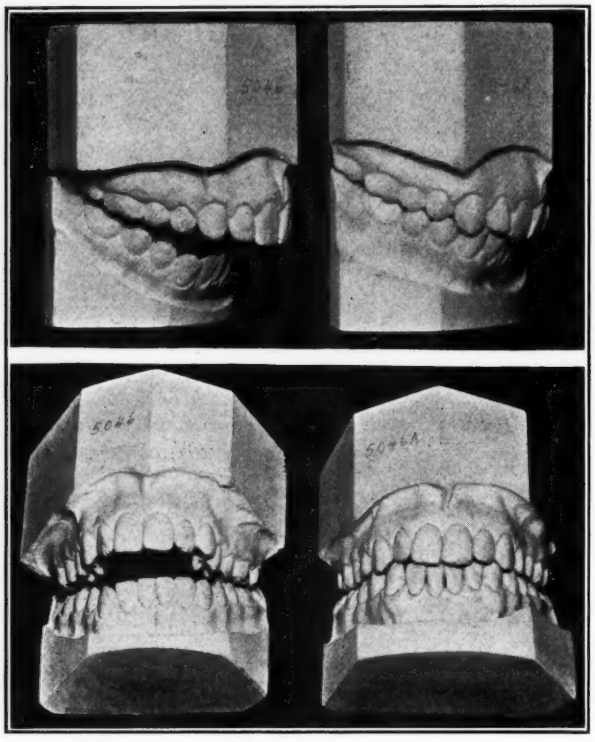

Fig. 4.

Case 2.—The second case was that of a girl sixteen and a half years of age, presenting the malocclusion as shown in Figs. 3 and 4.

History.—The early history revealed some facts which may have been contributing causes. A disturbance in growth was evident at an early age, since the first incisors did not erupt until fifteen months and the remainder of the deciduous denture was equally tardy. At the age of seven years the patient was observed to have difficulty in nasal breathing, and the tonsils and adenoids were removed at that time.

The malocclusion was not noticed by the family or the dentist until the age of twelve years. This is in contrast to Case 1 which was evident much earlier and may be of significance, as this is the age at which there is a period of accelerated growth in the posterior region of the face.

As in Case 1 the patient had developed a tongue habit which would aggravate the condition but which was not considered to be a cause (Fig. 5). The patient was overweight, with poor muscle tone generally, manifested by the stooping shoulders and the difficulty in holding the head erect. The muscles of mastication and expression were hypotonic, causing a drooping at the corners of the mouth and a slackness of the sublingual muscles. A noticeable exception was the mentalis muscle, which was contracted in an effort to compensate for the open-bite. This condition is typical of open-bite cases and tends to persist after the malocclusion is corrected. There was also some impairment in hearing.

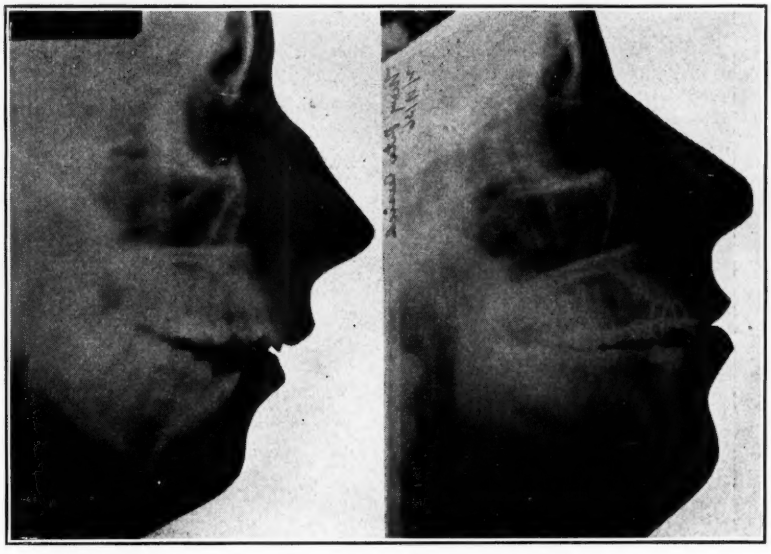

Fig. 5.

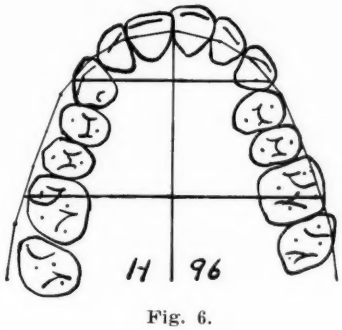

Fig. 6.

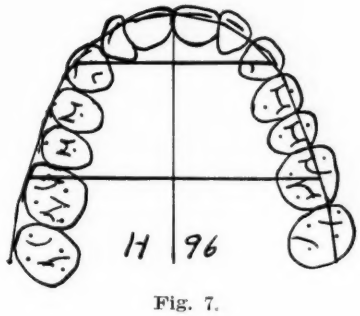

Fig. 7.

Diagnosis.—Gnathostatic models and charts (Figs. 6 and 7) were made of the case together with x-ray pictures and photographs.

This case could scarcely be classified as infraclusion of the teeth, as the whole mandible was involved distal to the second molar. A more accurate term might be total mandibular abstraction (Simon's classification). The angle and the distance of the maxillary teeth to the horizontal plane were within normal limits, while the angle of the mandibular occlusal plane was 25 degrees from the horizontal. Further complications were the contracted maxillary arch and the distoclusion.

Etiology.—It is difficult to ascribe a definite cause to cases of this type. It is evident that the phase in the development of the mandible which causes the ramus to increase in height and the angle to become more acute has been retarded. Dr. Calvin Case (J. A. D. A.) in 1917 asserted that mouth-breathing with the consequent pressure from the hyoid muscles acted as a second class lever upon the mandible.

Fig. 8.

Fig. 9.

Other suggested causes have been the inhibition of the growth centers through interference with blood supply.

Prognosis.—Only fair. Several factors, such as the poor posture and general health of the patient, were unfavorable to the successful treatment of this case.

Treatment.—I shall outline the treatment briefly. Proper arch form was obtained in the conventional manner with lingual wires, and the mesiodistal relation was corrected by means of myofunctional therapy. Gum rubber pads

were used in conjunction with the masseter-temporal exercise. Exercises were also prescribed to obtain better posture and to give tone to the muscles of expression. It was necessary for the patient to wear vertical elastics to finish closing the bite but not to draw the mandible forward.

A Hawley retainer and a mandibular cuspid-to-cuspid retainer were used to retain the arches until function was established.

CASE 1		CASE 2
	History	
Habit formed at 7 or 8 years of age.		Began at 12 years of age.
	Etiology	
Known habit.		Obscure. Retarded development.
	Diagnosis	
Local infraclusion. Neutroclusion.		Gross anomaly. Involves whole mandible. Distoclusion. Figs. 3 and 4.
	Prognosis	
Good.		Fair.
	Treatment	
Simple breaking of habit.		More difficult; unfavorable factors.
	Result	
Early correction restores normal function.		Functional occlusion. Change of expression. Psychological effect. Figs. 8 and 9.

Department of Oral Surgery

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EXTRAORAL METHOD OF REGIONAL ANESTHESIA IN THE SUPERIOR MAXILLA*

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REGIONAL anesthesia had its inception with the introduction of novocaine as an agent for local anesthesia. Its practical development gained momentum and steadily progressed as this new anesthetic gradually and, as time went on, almost completely replaced cocaine as a local anesthetic in dentistry. Braun,[1] a pioneer in this work, was a strong advocate of this method of anesthesia. In his textbook he described, in detail, the approach to the superior maxillary nerve both from within and from without the mouth. Of the two methods he seemed to favor the extraoral approach. Thus, he wrote, "The infraorbital foramen can be reached by passing a needle beneath the upper lip when the mucosa is reflected in the alveolar process along the anterior surface of the upper jaw to the point of emergence of this nerve, or better, by passing the needle from without directly into the infraorbital foramen. . . ."

Fischer,[2] at a later date, in elaborating on the technic of Braun, advanced the belief that of the two methods of approach in regional anesthesia the intraoral route was the best. This method was soon adopted, without hesitation, by the dental profession at large. It became the technic of choice of the dental surgeon whenever regional anesthesia was desired.

The otolaryngologist, on the other hand, in accepting the intraoral method did not do so to the exclusion of the extraoral route. He has employed, at different times, either the one or the other method. In the past year or two, furthermore, the pendulum has swung to the extraoral method, and one of us (J. N. N.) has employed the extraoral route, with a good deal of success, in antrum surgery and in rhinoplasty.

Our endeavor in this presentation is to demonstrate the superiority of the extraoral method of injection over the intraoral route. Our conclusions are based on the findings in a series of fifty cases in which the extraoral method

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was used exclusively. Before going into the discussion of these cases and the results obtained, however, we deem it advisable to take up, in detail, the following:

1. The anatomy of the superior maxilla and the maxillary nerve.
2. Types of local anesthesia in the superior maxilla.
3. Our technic for the extraoral method.

The term infraorbital nerve has been assigned to that portion of the maxillary division of the trigeminal nerve which runs through the orbital cavity, in the infraorbital groove and canal. It seems to us that it would be more proper, and far less confusing, if the name maxillary should be applied to the entire length of the nerve, from its origin at the semilunar ganglion to its termination

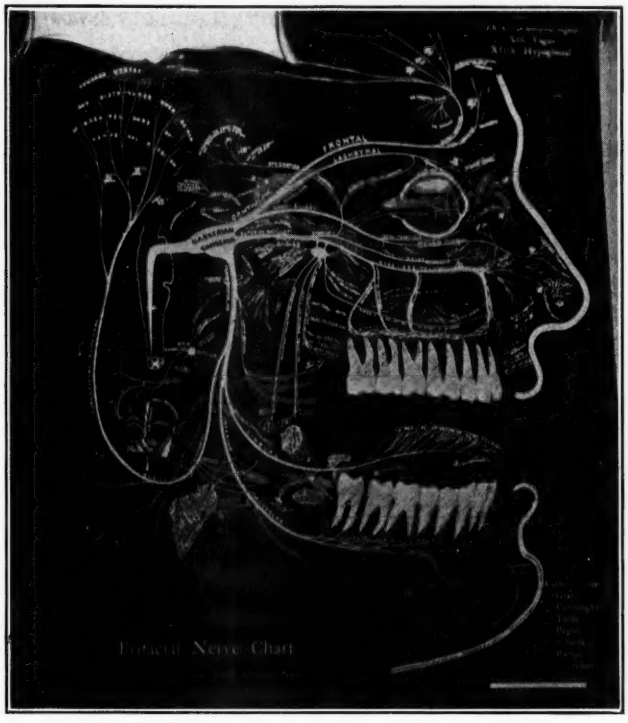

Fig. 1.—Trifacial nerve chart (Nevin).

at the infraorbital foramen. The latter term is especially appropriate in this discussion, since most of the branches of the maxillary nerve are concerned. The infraorbital portion of this nerve supplies only the premolar, the canine, and the incisor teeth. It is not concerned with the nerve supply to the molar teeth. In the following discussion of the anatomy of the nerve, therefore, we shall speak of the maxillary nerve and omit the term infraorbital.

The maxillary nerve originates from the semilunar ganglion, at its bed on the superior surface of the apex of the petrous portion of the temporal bone, as a flat plexiform trunk. It leaves the cranium through the foramen rotundum. After crossing the pterygomaxillary fossa it inclines lateralward, in back of the maxilla, to gain entrance to the orbit through the inferior orbital fissure. Here the nerve takes a forward and inward direction, in the infraorbital groove and canal, and emerges through the infraorbital foramen.

The maxillary nerve gives off branches at various points along its course. These may be classified as follows:

1. *In the cranium*—middle meningeal
2. *In the pterygomaxillary fossa*—zygomatic
   sphenopalatine
   posterior superior alveolar
3. *In the infraorbital canal*—anterior superior alveolar
   middle superior alveolar
4. *On the face*—inferior palpebral
   external nasal
   superior labial

In exodontia, as in sinus surgery and in rhinoplasty, all these branches have to be dealt with. It therefore seems advisable to consider them in some detail. Points of supply not of interest in our discussion will be omitted.

The sphenopalatine branches, two in number, go into the formation of the sphenopalatine ganglion. The latter sends branches to supply the palate, the palatal side of the gum, and the lining membrane of the nasal chambers.

The posterior superior alveolar branches, two in number, arise just before the nerve enters the infraorbital groove, descend on the tuberosity of the maxilla and give off branches to the gums and the neighboring mucous membrane of the cheek. They then enter the posterior alveolar canals in the infratemporal surface of the maxilla and, passing forward in the substance of the bone, give off branches to the mucous membrane of the antrum and to each of the molar teeth.

The middle superior alveolar branch leaves the main trunk in the posterior part of the infraorbital canal, runs downward and forward in a canal in the lateral wall of the antrum. It supplies the latter and each of the premolar teeth.

The anterior superior alveolar branch comes off the main trunk, in the infraorbital canal, just before it makes its exit through the infraorbital foramen. It descends in a canal in the anterior wall of the antrum, supplying the mucous membrane of the latter, and sending twigs to the incisor and canine teeth.

The terminal branches of the alveolar nerves discharge themselves finally through the spongy bone into the pulps of the individual teeth as "dental branches," into the interdental septums as "interdental branches," and into the papillae as "gingival branches."

The inferior palpebral, external nasal, and the *superior labial* branches supply the lower eyelid, the side of the nose, and the upper lip respectively.

The infraorbital foramen occupies a position above the canine fossa and underneath the infraorbital ridge, below and lateral to the anterior bony nasal aperture. It forms the entrance to the infraorbital canal and transmits the infraorbital vessels and the terminal portion of the maxillary nerve.

From before backward, the infraorbital canal begins at the infraorbital foramen (Fig. 2), runs at first upward, backward, and outward, for a distance of 1 cm., and forms an acute angle of about 45 degrees with the anteroposterior

diameter. It turns directly backward, in a line parallel to the anteroposterior diameter, and continues as the infraorbital groove to reach the inferior orbital fissure.

The anterior superior alveolar nerve anastomoses with the middle superior alveolar and the posterior superior alveolar to form the external superior dental plexus. It also anastomoses with its fellow across the midline. The latter fact accounts for the necessity of injecting the apex of the opposite incisor when wishing to extract the incisor and the canine teeth.

The outer loop or external plexus therefore supplies the teeth in the corresponding half of the jaw, the buccal and labial alveolar processes, the periosteum, the gum tissue, and the mucous fold.

The nerve supply in the lingual aspect of the teeth is derived from the internal plexus formed by the anterior palatine and nasopalatine nerve branches which arise from Meckel's ganglion in the pterygopalatine fossa.

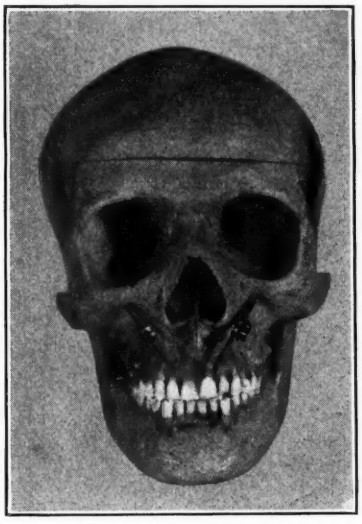

Fig. 2.—Probes and needles pointing to direction of infraorbital canal.

Local anesthesia in the superior maxilla may be produced by one of two methods, infiltration and regional. The former, the simpler of the two, is the one universally employed by the general practitioner in dentistry, while the latter method is seldom employed by the general practitioner.

By infiltration anesthesia we mean anesthesia produced in a definite portion of the jaw, induced by injection through the oral mucosa. The anesthetic, in infiltrating the tissues, acts upon the contained nerve elements and renders them functionless. Injection is made through the mucosa near the alveolar bone into the submucosa and the underlying periosteum. This is accomplished with some difficulty, in view of the density of the alveolar mucosa and the tenseness with which it is attached to the alveolar bone. To obtain good anesthesia in the alveolar bone and in the teeth the anesthetic must be carried into the mucobuccal fold under moderate pressure and at slow rate. Excessive pressure may cause laceration of the minutely reticulated cell network, edema and pain, in addition to the improper infusion of the anesthetic. The condition of the mucosa

is a great factor in the result obtained. Occasionally the mucosa has so little resistance that it tears even under the most careful manipulation. This is especially true in the old and in debilitated patients, and in those having diseased gums.

Regional anesthesia, also called conduction anesthesia, differs from the above method in that the entire peripheral area, supplied by the nerve injected, is anesthetized. The anesthetic solution is injected in the vicinity of a fair sized nerve trunk, where it penetrates the perineurium and gains entrance into the interior of the nerve. This produces inhibition in the function of the nerve trunk and results in the blocking of the peripheral sensory stimuli from reaching the central organ.

In exodontia of the superior maxilla, regional anesthesia is produced by injecting the anterior superior alveolar plexus at the infraorbital foramen if the incisor, canine, or the first premolar tooth is to be extracted; or by injecting the posterior superior alveolar nerve at the tuberosity if the second premolar or any one of the molar teeth is to be removed. These injections are supplemented by palatal anesthesia.

The so-called infraorbital injection may be accomplished by either the intraoral or the extraoral route. The former method is used by most of the dental specialists, while the latter is not employed in dentistry. The intraoral method is performed by inserting the needle into the mucous fold of the root apex of the canine tooth and directing it vertically upward. When the infraorbital foramen is reached, the solution is injected and the needle is withdrawn. Many dental specialists use other teeth as landmarks for the initial insertion of the needle. Some authors advise that this injection should be followed by gentle massaging over the external area injected. With this manipulation, they claim, the anesthetic is pressed into the infraorbital canal.

In considering the anatomic structure of the infraorbital foramen and canal, especially with reference to the direction taken by the canal as it runs backward in the floor of the orbit, one cannot help but realize the inadequacy of the intraoral method. Simply depositing the anesthetic fluid in the infraorbital foramen and massaging the external surface is not sufficient to produce good anesthesia. To anesthetize the infraorbital portion of the maxillary nerve one has to insert the needle into the infraorbital canal and inject the anesthetic fluid into or around the nerve. This procedure can be accomplished only by the extraoral method. We have employed this method at the Graduate Hospital for extraction of teeth and minor oral surgery in a series of 50 cases, and have obtained satisfactory results. We have managed to extract painlessly any and as many of the teeth as were necessary with a single extraoral injection and without the aid of a palatal injection. Where a canine or an incisor had to be extracted, we supplemented this injection with a few drops of the anesthetic solution at the root of the opposite incisor. This was done to block the anastomosing fibers from the opposite side.

The armamentarium for our method of injection includes the following:

1. Tincture metaphen (Abbot)—a tinted alcohol-acetone-metaphen solution 1:200.
2. Alcohol—70 per cent solution.

3. Novocaine—2 per cent solution.
4. Adrenalin chloride—1:1000 solution. Ten drops (♏) of the adrenalin are added to each half ounce of the 2 per cent novocaine, to make a dilution of 1:25,000.
5. Luer-Lok syringe (B-D)—3 c.c.
6. A fine short needle—27 gauge.
7. A large needle—1½ in. long, 25 gauge.
8. A metal centimeter rule—one that can be sterilized.
9. A fine metal applicator. This is used as a marker for outlining the point of injection.

Fig. 3. Fig. 4.

Fig. 5. Fig. 6. Fig. 7.

Fig. 3.—Outlining point of injection. Vertical line, at a distance of 1 cm. from the inner canthus of the eye (*1*), straight line from lower border of the columella (*2*), and the outer canthus of the eye (*3*), intersecting at point of injection.

Fig. 4.—Site of injection at intersection of the two lines.

Fig. 5.—Skin infiltration in preparation to deep injection. Small needle used.

Fig. 6.—Wheal produced after infiltration at point outlined. Area washed off with alcohol after the wheal is produced.

Fig. 7.—Deep injection with large needle, inserted in the direction of the oblique line.

In about 80 per cent of the cases in our series we used the novol 2 c.c. anestubes in conjunction with the novol anestube syringe and rustless steel needles. These anestubes contain 2 per cent novocaine in epinephrine hydrochloride solution 1:30,000, a buffered solution of $pH^{6.7}$, compatible with the H-ion of human blood. Anesthesia was very satisfactory and complete.

The technic employed for the extraoral injection, in detail, is as follows. The anterior part of the cheek, from the edge of the lower eyelid down to the lower edge of the upper lip, and including the side of the nose, is painted with tincture metaphen and washed off with alcohol. Using tincture metaphen again, a line is drawn vertically from the lower eyelid down through the upper lip, at a distance of one centimeter from the inner canthus of the eye (Fig. 3) on the side of injection. Another straight line is drawn between the nasal spine, represented by the lower border of the columella, and the outer canthus of the eye on the side of the injection. The point of intersection of these two lines marks the site of injection (Fig. 4). At this point a few drops of the anesthetic are injected intradermally with a fine short needle of 27 gauge (Fig. 5), and a small wheal is produced (Fig. 6). A larger needle, 1½ in. long and 25 gauge, is then substituted for the small needle and introduced through the wheal, in a direction upward, backward, in relation to the vertical axis of the head, and at an angle of 45 degrees to the anteroposterior diameter, whereupon it enters the infraorbital foramen (Fig. 7). It is then advanced into the infraorbital canal for a distance of 1 cm., and the anesthetic is deposited slowly and cautiously. Resistance to the injection should be encountered at all times, and absence of such should lead operator to suspect that the needle has entered the orbit. The needle is then withdrawn, the area cleansed with alcohol, and a few minutes are allowed to elapse before extraction is resorted to.

With this technic and without the aid of any supplementary injection, we have managed to extract any and as many of the teeth in the superior maxilla on the side of injection as were necessary. Anesthesia was found to be complete on both the buccal and the lingual side of the gum. This fact led us to believe with Shuster and Decker[3] that in injecting the anesthetic into the infraorbital canal it is forced as far back as the sphenopalatine ganglion. These authors injected methylthionine chloride into the infraorbital canal, dissected the periorbita, and found the fluid in the entire infraorbital canal, in its tributaries, and in the region of the sphenopalatine ganglion.

Our series consisted of fifty cases referred to the dental clinic of the Graduate Hospital of the University of Pennsylvania, from the various services and departments of the hospital. Each patient was informed exactly as to what was going to be done, and assured that there were going to be no unpleasant consequences of any sort, before anything else was done. Our aim in doing this was to set the patient's mind at ease and get the patient in a receptive mood. A good many patients were, at first, skeptical, and hesitated to submit to this new form of injection, but further assurance and patient management invariably provoked confidence. The postoperative reactions were pleasing and encouraging. Some of the patients were actually amazed at the ease with which their teeth were extracted.

Analysis of Table I discloses the gratifying results we obtained in our series. Anesthesia was complete in 48, or 96 per cent of the cases. Two cases were doubtful as to the completeness of the anesthesia. Forty-two of the patients required no supplementary injections, while eight patients, in whom the canal could not be entered, required supplementary palatal injections. In one of these eight cases a tuberosity injection was also necessary to complete the

anesthesia. In the column under the heading "teeth extracted" we can see the number and variety of teeth extracted with this single and unsupplemented injection. In each of these cases canine, premolar, and molar teeth were extracted without the least bit of pain or discomfort to the patient. The postoperative reactions were without any unpleasant sequellae. In three of the

TABLE I

CASE	NAME	DATE	DEP'T	RACE AGE	SYRINGE	AMT.	SIDE	TEETH EXTRACTED	ANESTHESIA	SUPPLEMENT
1	J. M.	2/11	Med.	B 34	Luer-L	2 c.c.	L	1Pm2 rPm-1 & 2	Good	None
2	J. H.	2/22	Acc.	B 35	Luer-L	2 c.c.	L	Pm2	Good	None
3	E. A.	2/25	Med.	B 27	Luer-L	2 c.c.	L	Roots—few	Good	None
4	M. E.	2/25	Med.	B 22	Luer-L	2 c.c.	R	Roots—3	Good	None
5	N. T.	2/25	Med.	W 41	Luer-L	2 c.c.	R	Pm1	Good	None
6	A. B.	2/27	Med.	B 46	Luer-L	2 c.c.	R-F	M2-I1 2	Good	T P
7	E. B.	2/29	Skin	B 20	Luer-L	2 c.c.	L-F	No oper.	Doubtful	None
8	T. C.	2/29	Orth.	B 40	Luer-L	1 c.c.	L	11 & 2, C	Good	None
9	L. P.	2/29	Card.	B 47	Luer-L	2 c.c.	L & R	rPm1 lI2	Good	None
10	D. K.	3/ 3	Orth.	W 77	Luer-L	2 c.c.	R	I1	Good	None
11	S. S.	3/ 3	Bron.	W 59	Luer-L	2 c.c.	R	Pm2 M1	Good	None
12	A. B.	3/ 3	Med.	B 46	Novol	1 c.c.	L-F	Pm1 & 2	Doubtful	Palatal
13	D. K.	3/ 5	Orth.	W 77	Novol	2 c.c.	L	12	Good	None
14	M. M.	3/ 5	Eye	W 46	Novol	2 c.c.	L	M1	Good	Palatal
15	M. H.	3/ 5	Med.	B 48	Novol	2 c.c.	L	C Pm1 & 2	Good	None
16	C. S.	3/ 5	Med.	W 42	Novol	2 c.c.	R	C	Good	None
17	M. H.	3/10	Med.	B 38	Novol	2 c.c.	R	12 C	Good	None
18	G. G.	3/10	Orth.	W 46	Novol	2 c.c.	R	C 12	Good	None
19	L. H.	3/10	Med.	B 35	Novol	1½ c.c.	R	I Pm1	Good	None
20	R. F.	3/10	Med.	W 49	Novol	2 c.c.	R	C Pm1 & 2	Good	None
21	G. G.	3/12	Orth.	W 46	Novol	2 c.c.	L	C Pm1 & 2	Good	None
22	M. P.	3/12	Med.	B 46	Novol	1 c.c.	L	Pm2 M1	Good	Palatal
23	B. M.	3/14	Med.	B 44	Novol	2 c.c.	L	Pm1 C	Good	None
24	F. M.	3/17	Med.	B 43	Novol	2 c.c.	L	I1 & 2 M1	Good	None
25	G. K.	3/17	Med.	B 34	Novol	2 c.c.	L	I1 & 2	Good	None
26	D. E.	3/19	G. I.	B 22	Novol	2 c.c.	L	I1 M1	Good	None
27	J. G.	3/19	G. I.	W 38	Novol	2 c.c.	L	M1	Good	None
28	M. E.	3/19	Card.	B 53	Novol	2 c.c.	L	M1 Pm1 & 2 C	Good	None
29	S. T.	3/19	Chest	B 32	Novol	2 c.c.	L	CPm1 & 2, M1, 2, 3	Good	None
30	J. B.	3/21	Eye	B 45	Novol	2 c.c.	R	M1	Good	None
31	M. E.	3/24	Card.	B 53	Novol	2 c.c.	R	M1 & 3 Pm1 & 2	Good	None
32	F. M.	3/24	Med.	B 43	Novol	2 c.c.	R	M3 C I1	Good	None
33	L. S.	3/26	G. I.	W 46	Novol	2 c.c.	L-F	C	Good	Palatal
34	M. B.	3/26	Orth.	W 53	Novol	2 c.c.	R	Pm2	Good	None
35	V. C.	3/31	ENT	B 41	Novol	2 c.c.	L	Pm1 & 2 M1	Good	None
36	D. R.	3/31	Metab.	W 55	Novol	1 c.c.	R	C I2	Good	None
37	W. F.	3/31	Metab.	W 59	Novol	1 c.c.	R-F	M1 & 2	Fair	Palatal
38	E. G.	4/ 4	Aid	B 19	Novol	2 c.c.	L	Pm1	Good	None
39	G. P.	4/ 7	Skin	B 59	Novol	2 c.c.	R	12 C Pm1 & 2	Fair	Palatal
40	E. B.	4/ 9	Eye	B 48	Novol	1½ c.c.	L	Pm1	Good	None
41	A. H.	4/11	Immun.	B 29	Novol	1 c.c.	L	C	Good	None
42	N. J.	4/14	Gyn.	B 28	Novol	2 c.c.	R	Pm1	Good	None
43	W. E.	4/16	Med.	B 41	Novol	2 c.c.	L-F	Pm1	Good	None
44	F. F.	4/25	Med.	W 54	Novol	2 c.c.	R	M1	Good	None
45	L. S.	5/ 5	G. I.	W 46	Novol	2 c.c.	L-F	12	Good	Palatal
46	R. F.	5/ 5	Med.	W 49	Novol	1 c.c.	R	12 C Pm1	Good	None
47	F. F.	5/ 7	Med.	W 19	Novol	1 c.c.	R	Pm1 M1 & 2	Good	None
48	C. W.	5/12	Med.	B 52	Novol	1 c.c.	L	C Pm2 M3	Good	None
49	B. W.	5/14	Med.	B 51	Novol	2 c.c.	R & L	CPm2M1-I2 CPm2	Good	None
50	G. R.	5/14	Orth.	W 42	Novol	2 c.c.	R	Pm1 & 2	Good	None

F signifies the cases in which the canal could not be entered, and the anesthetic was deposited into the foramen. In these cases a supplementary injection was necessary.

Three of the patients developed discoloration underneath the eye.

cases in our series we encountered some ecchymosis at the area of injection, a complication which was taken care of by cold topical applications.

Thus, to recapitulate, the extraoral method of injection, in our estimation, has a decided advantage over the intraoral method. The anesthetic can be deposited into the infraorbital canal and, as stated above, directed as far back as the sphenopalatine ganglion. The anterior palatine and the nasopalatine nerves are also anesthetized with the same injection. Supplementary injections of these nerves, necessary with the intraoral method, are thus disposed of. These facts were not taken for granted by us, and each patient was tested for pain with a sharp explorer on both the buccal and the lingual side of the gum before extraction of any of the teeth was attempted.

Other features which, we believe, make the extraoral method more desirable than the old technic are the following:

1. The needle can be felt under the palpating finger and can thus be guided in the proper direction.

2. The skin can be sterilized with greater ease than the mucous membrane of the mouth. The needle is therefore carried through a cleaner field than it is in the old intraoral method.

3. The needle can be directed into the infraorbital canal thus allowing the anesthetic to be deposited farther back along the nerve.

4. Infection of the mouth or the teeth, such as Vincent's angina or a tooth abscess, does not contraindicate local anesthesia, since with our method the infected area is avoided.

Case Report.—C. H., adult male, reported to the accident clinic of the Graduate Hospital with an acute abscess of the maxillary left canine. Nitrous oxide was administered for incision and drainage of the abscess. The patient was an alcoholic and responded poorly to the anesthetic. The surgeon then referred the patient to the dental clinic for further treatment and advised that we use local anesthesia for extraction of the tooth. By the use of our technic, the tooth was extracted painlessly in the presence of the acute swelling.

5. Anesthesia is widespread, extending from the incisor to the last molar tooth, on the side of the superior maxilla injected. This makes it possible to extract any and as many of the teeth as are necessary in the superior maxilla, on the side of injection.

6. Operative dentistry, such as cavity preparation, pulp extirpation, and apicoectomy, is possible under our technic of regional anesthesia; since the anesthesia is profound enough for such extensive manipulations.

One of the questions that arose in connection with our method of injection was the legality of this procedure in the hands of the dentist. We have considered this and discussed it at length with representative members of the dental and medical professions and a legal representative of one of the medical protective insurance companies. The latter expressed the belief that our method would be out of the realm of the dental profession, since it is not the method in general use today. Should a complication arise, he added, the dentist would be in a precarious situation. The members of the allied professions held a view to the contrary. The opinion of a dental educator was that the passing of a

needle through the skin would be no more out of the realm of the dental profession than the administration of a heart stimulant, the external incision of an alveolar abscess, or the administration of a general anesthetic. A nationally known otolaryngologist held the same view as that of the dental educator. He believed that there should be no obstacle to this method of injection, "as in the cavalcade of dental and medical progress what seems to be unusual today may be the accepted thing of tomorrow."

An important feature that the surgeon should consider before employing this method of injection is the psychologic reaction of the patient. Human beings are inclined to welcome the accepted way of doing things and to look with askance at anything that is new or unorthodox. Yet the mind is open to suggestion, and careful and delicate handling of the patient is usually rewarded with confidence. The patient should be told, in full detail, exactly what is going to be done. He should be assured that there will be no disfiguring blemish at the site of injection following this manipulation. The surgeon should make sure that the neurotic, the cardiac, and the diabetic are properly premedicated. The needles should be sharp and of proper gauge. The anesthetic agent should be pure and free from contamination. Postoperative instructions should be explicit and in detail. And last, but not least, the surgeon should assure the patient, before the latter leaves the office, that everything is fine.

In conclusion we wish to reiterate and emphasize the fact that the extraoral method of regional anesthesia in the superior maxilla, as performed with our technic, is by far superior to and more exact than the intraoral method. We are fully convinced that this method is the one of choice, inasmuch as only with this method of approach can the needle be carried into the infraorbital canal for the desired distance. The technic is simple and easy to perform if the operator is thoroughly acquainted with the anatomy of the area involved. The approach is more direct and asepsis is more easily obtained. The injection, if properly performed, will produce widespread anesthesia, and allow extraction of any and as many of the teeth in the superior maxilla, on the side injected, as are necessary. No supplementary injections are required if the anesthetic is carefully deposited in the infraorbital canal. Operative dentistry can be performed with this local injection as effectively as with a general anesthetic, and at the same time avoiding the untoward effects of the latter. The psychologic reaction of the patient should be considered and his confidence gained before any operative procedures are instituted.

REFERENCES

1. Braun, Heinrich: Local Anesthesia, Philadelphia, 1914, Lea & Febiger.
2. Fischer, Guido, and Groosman, L.: Local Anesthesia in Dentistry, Philadelphia, 1933, Lea & Febiger.
3. Shuster, Benjamin H., and Decker, W. Clyde: Local Anesthesia in Radical Operations on the Maxillary Sinus, Arch. Otolaryng. **20**: 67, 1934.

DENTAL ABNORMALITIES IN A PATIENT WITH ACHONDROPLASIA*

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A FAIRLY comprehensive fund of information concerning the interrelationships of dental and general systemic disease has been accumulated. The recognition and treatment of local focal infections within the oral cavity have resulted in many cases of successful ameliorization of remote pathologic conditions.

Of no less importance to both dental and medical progress has been the development of information concerning the influence that general diseases may play in the causation of dental infections and abnormalities. The older clinicians, at whose powers of observation we marvel today, used to spend a great deal of time in examining the tongue and the mouth. They saw there many diagnostic signs. They recognized the early Koplik spots of measles, the mucous patches of secondary lues, the smooth atrophy of the tongue in anemia, and the gingival discolorations in heavy metal intoxications. They came to realize that the notching of the teeth was part of the triad described by Hutchinson as a sign of syphilis, and were aware of scurvy by the puffiness of the patient's gums and loosening teeth.

The advance in knowledge which resulted from the use of the microscope and the development of chemical and bacteriologic laboratory technic, showed many more such general disease-dental reflections. Puffy gums, sloughy gingival ulcers, premature loosening of the teeth, mottling of the enamel, various hypoplasias, came to suggest the need of more than local examination, and such diseases as leucemia, agranulocytosis, diabetes, fluorine poisoning, and rickets were found in the background, sometimes being the very first manifestation. The need for appreciation by the dental and medical professions of their mutually related problems has thus become increasingly apparent.

One of the most rapidly expanding fields of medicine at the present time is the study of the function of the ductless glands and their endocrine products. Dental changes which seem to depend upon disturbance in endocrine function have been noted. The bizarre picture of the acromegalic giant with his protruding mandible has been ascribed to pituitary dysfunction. Osseous changes consisting of multiple cysts—some of which may occur in the jaws—have been found to be due to parathyroid disturbances. There are a number of other osseous derangements which have not as yet been so clearly elucidated either as to their etiology or in the description of the dental pattern which is encountered. As information concerning these diseases is developed, possibly some dental abnormality might serve as a diagnostic criterion in recognizing their presence.

The present report is concerned with a clinical description of a patient suffering from achondroplasia. This disturbance of growth in the cartilaginous

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portion of the bones was first described by Ollier in 1878. Cessation of growth in these centers is the essential abnormality. A severe grade of the disease produces dwarfs. While the disease, the etiology of which is still very obscure, seems to involve chiefly the long bones, in some cases the skull and clavicle are affected, and, as will be noted, the teeth as well. Clinical studies of patients reveal that the disease is likely to affect several members of the same family and that the patient is likely to have associated congenital defects, particularly supernumerary digits.

Dental dystrophies associated with achondroplasia were described by Hesse (1925, 1926), Frey and Ruppe (1931), Hermann (1932), and Heupel (1935). The chief findings consisted of maldevelopment and retention of the deciduous teeth, absence or greatly retarded eruption of the permanent teeth, and marked malocclusion.

Fig. 1.—Comparison of patient's hand (left), with that of a normal person (right).

The patient in this report is a thirteen-year-old Italian girl. She was third of five children, being the only member of the family to have achondroplasia or any dental dystrophies. In appearance she is dwarflike. She was first brought under observation at the age of one year for the removal of a supernumerary digit on each hand (Fig. 1). At the age of eleven years she was readmitted for pyelitis and manifest bony changes in her legs. Examination of the kidneys did not reveal any congenital abnormalities. X-ray pictures of the long bones demonstrated marked outward bowing of the knees and intrinsic bony changes. The lateral half of the epiphyseal center of ossification in each tibia was markedly flattened. The x-ray appearance was consistent with a diagnosis of achondroplasia. It was noted at that time that there was a striking absence of the mandibular teeth, and that the maxillary incisors were sharply pointed. Laboratory studies revealed a negative Wassermann and normal calcium and phosphorous determinations.

By the next year she was readmitted because of difficulty in walking. Her knees had given way under the strain of carrying her body and had bent outward so markedly that she could walk only by laboriously circumducting her legs. The laboratory determinations of the Wassermann, calcium, and phosphorus were again normal. The deformity was corrected by operation. Good healing took place, and function was restored.

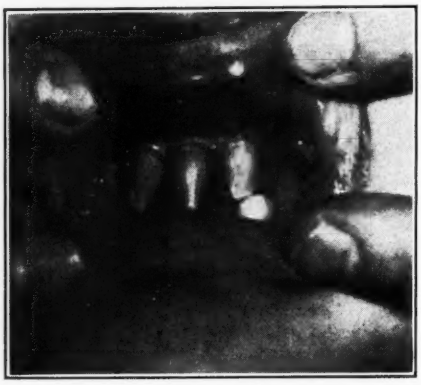

Fig. 2.—Malformation of incisors.

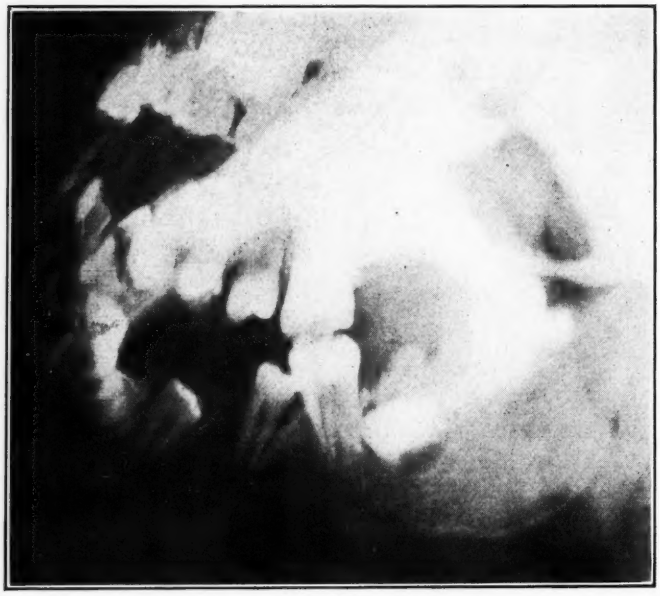

Fig. 3.—Radiograph of right side of jaws.

A detailed examination of the oral cavity at that time revealed several interesting findings. The mandible in this thirteen-year-old girl was, but for the presence of two very loose diminutive canines and two normal first molars, devoid of any other teeth. The mucous membrane over the edentulous areas was normal in appearance.

The dental formula was:

$$\frac{6\ 5\ 4\ 3\ \ 1 \mid 12\ \ 3\ 4\ 5\ 6}{6\ \ \ \ C \mid C\ \ \ \ 6}$$

The maxillary incisors are interesting because of their very peculiar form. The three incisors are formed like a smooth cone tapering down to a sharp point at the incisal tip. They are widely spaced and resemble the teeth of a saw. The right maxillary second incisor is absent (Fig. 2).

A space resembling a diastema is present bilaterally posterior to the incisors. X-ray examination does not reveal the missing right second incisor, nor any supernumerary teeth. There is no osseous defect of the palatal bone to suggest a latent cleft palate.

The canines are quite dissimilar from the usual modal form in that the lingual cusp is very prominent and high, and therefore resembles the premolar form rather closely. However, two well-formed premolars and first molars are next in situ. The second molars are not present. X-ray examination reveals about one-half of the crowns of these teeth to be present. No third molar buds are seen. No history of the loss of any of the permanent teeth could be obtained.

As mentioned above, the mandible did not show any erupted incisor teeth. X-ray examination did not reveal any to be present. The deciduous canines are diminutive, of typical form, and very loose. The only other teeth present are the first molars, which are well formed. X-ray pictures show that the canines, premolars and second molars are present in the partially formed state. No third molar buds are seen (Fig. 3). The erupting teeth are not only retarded but quite disorganized, as the teeth are irregularly spaced and tilted backward. The mandible is oversized for the erupting complement of teeth, as rather wide spaces exist between them. The osseous structure appears normal.

In general, the teeth, including the peculiarly pointed incisors, have smooth unbroken enamel with no caries. No hypoplasia, such as is found in rickets and odontoplasia, is present.

SUMMARY

The dental abnormalities which were noted in a thirteen-year-old Italian girl who had achondroplasia were as follows: (1) disturbed genesis of the teeth as represented by the complete absence of the maxillary second incisor, all the mandibular incisors and both maxillary and mandibular third molars; (2) disturbed development as evidenced by the partially formed mandibular canines, premolars, and both the maxillary and the mandibular second molars; (3) disturbed eruption since the mandibular canines, premolars and all second molars are unerupted; and (4) a peculiar abnormality of shape represented by the bizarre conical maxillary incisors.

REFERENCES

Frey, L., and Ruppe: Pathologie de La Bouche et Des Dents, p. 140, 1931.
Herrmann: Ein Fall von Dysostosis Cleidocranialis, Verhandl. f. Zahnh. **48**: 471, 1932.
Hesse: Dysostosis cleidocranialis unter besonderer Berucksichtigung des Gebisse, Verhandl. f. Zahnh. **41**: 1925.
Hesse: Befunde am Zahnsystem dysstotischer Individuen, Ztschr. f. Stomatol. 1926.
Heupel, R. G.: J. D. Res. **15**: 186, 1935.

HEALING OF BONE FOLLOWING INJURY*

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CONDITIONS responsible for the production of the so-called "dry socket," the slow healing of a wound following the removal of an impacted tooth, and the resorption of bone producing the periodontal lesion are receiving much thought by the oral surgeon and the periodontist. Recent advances in physiologic chemistry have changed many of the old theories of bone repair that are applicable to this problem.

The classical description of the healing of a fracture by Clay Ray Murray[1] exemplifies these new beliefs. Murray states that "All fractures heal as do wounds elsewhere, unless there is a mechanical, chemical, or anatomic bar to the healing. This healing, in common with that of wounds of the soft parts, takes place through the medium of new connective tissue known as granulation tissue. When referring to delayed union and nonunion, after any fracture, in which healing through granulation tissue has occurred, one in reality refers to a delay or failure in the process of calcium deposition in the healing connective tissue which is commonly designated as new bone formation.

According to Murray, "Variations in the character and amount of the healing process in bone following fracture, are dependent on factors limited to the region of the body involved quite independent of the subject involved. Slow union and nonunion are not influenced by the age (per se) of the patient, by his general state of health, by the presence of chronic general disease, such as syphilis or cardiovascular or renal disease, by general wastings due to other causes, by general metabolic disturbances affecting either the general calcium and phosphorus metabolism (osteomalacia), or other phases of metabolism (diabetes), or by acute infectious disease.

"The preponderance of clinical and experimental evidence on the calcium and phosphorus levels of the blood during the healing of a fracture is unquestionably to the effect that there is no correlation between variations in these levels and variations in the healing process. In keeping with this are the clinical findings in osteomalacia and rachitis, in which healing is normal or slightly more rapid than normal after fracture, although there exists an actual negative balance in the former and an acknowledged metabolic disturbance in the latter."

Concerning the normal healing of bone following injury, Murray[1] says, "On the basis of recent observations, the process in healing of a fracture is one in which, following the injury and the resultant inflammatory processes, an acid pH of the local tissue fluids dependent on the interrelationship of tissue necrosis and circulatory efficiency, is associated with the decalcification of the dead bone at the site of the fracture. Such liberated calcium is held locally

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by a chemical absorption affinity between it and the fibrin of the hematoma and the collagen of the newly formed connective tissue, i.e., granulation tissue —growing from all directions along the fibrin network at the site of the injury, producing concentration of calcium about the fracture. With increased cell metabolism, and with interrelated increasing efficiency of circulation and the carrying away of the products of necrosis there is a reversion of this acid pH to the alkaline side, and coincident with this change there occurs a deposition of the locally absorbed calcium in the newly formed connective tissue to form new bone."

Factors outlined by Murray involved in the mechanism of the healing of fractures and capable of being clinically influenced are local pathology, the growth of granulation tissue, an available source of calcium for the ossification of the healing tissues, and a proper biochemical status of the local tissue fluid through the healing process.

Under local pathology the important item is the amount of tissue necrosis. When massive, it destroys available sources for the growth of granulation tissue and under all circumstances it creates a pH to the acid side in the hematoma (blood clot) and tissue fluids about the site of the fracture. This pH is of importance in the production of a local source of calcium, and is the essential early stage of the biochemistry of the tissue fluid.

The hematoma, or blood clot, influences the growth of granulation tissue through its fibrin content and the establishment of a local source of calcium under proper conditions of pH in the tissue fluids by acting essentially as a decalcifying fluid, and, through absorption affinitiy between calcium and its fibrin content, by holding the freed calcium in situ. It also serves as a basis of support or scaffolding for the building up of granulation tissue which replaces it.

GRANULATION TISSUE

The significance of the circulatory status of the part (including the lymphatic and tissue fluids), in the early and late stages of fracture healing, lies in its influence on the growth of granulation tissue, and on the establishment of, and the utilization of, a local source of calcium through its influence on pH of the tissue fluid.

CHEMICAL AND PHYSICAL BARS TO THE HEALING OF TISSUE

The influence of infection in producing continuous necrosis by chemical means, thus preventing primary healing, is obvious, and it has been demonstrated that with many suppurative processes there is established, even in the absence of excessive necrosis, an acid pH resulting in the decalcification of bone and in little or no calcium deposition in the granulation tissue which may, however, be overabundant.

ANATOMIC CHARACTERISTICS

The anatomic characteristics of the part, as outlined by Murray,[1] are frequently a reason for the lack of growth of granulation tissue. In a fracture occurring in a region such as the neck of the femur or the proximal half of the carpal scaphoid, there is naturally a varying amount of necrosis and circula-

tory damage. Because of the exceedingly minimal or even totally lacking circulatory status of the proximal bony fragments in each instance the source for the growth of granulation tissue and adequate accessory circulatory supply is in the surrounding soft parts. Thus scant growth of tissue occurs, often with so-called aseptic necrosis of the separated portions of bone.

The influencing factor in the production of the "dry socket" is the circulatory status within the injured area, influencing the growth of granulation tissue. Conditions responsible for circulatory insufficiency are trauma, infection, and an injury within an abnormal anatomic area.

The important item resulting from these conditions is tissue necrosis, which when massive not only destroys available sources for the growth of granulation tissue, but under all circumstances creates a pH to the acid side in the blood clot and tissue fluids in and about the wound. This change results in autolysis of the blood clot before granulation tissue is established.

Cameron and Gilmour[2] in discussing the subject of autolysis, say: "Conditions which facilitate the continuance of slight acidity in the tissues, such as deficient circulation, thus can lead to autolytic processes in living tissues, and such processes are involved in necrosis and gangrene."

When excessive trauma is produced in the removal of a tooth, infection follows, resulting in circulatory damage sufficient to produce autolysis of the blood clot and tissues within the area involved, thus influencing the growth of granulation tissue in producing continuous necrosis by chemical means.

Bell[3] in discussing this subject, says: "Necrotic tissue is an irritant and always incites an inflammatory reaction. The dead tissue acts as a foreign body, and in addition the soluble product of protein decomposition is toxic. In bacteria inflammation, dead tissue is of great practical importance, since it not only offers no resistance to the growth of bacteria, but favors their growth by supplying them food material while they become established in the tissue. The growth of bacteria in dead tissue is further favored by the fact that immune bodies and leucocytes cannot reach them readily, because of the destruction of blood vessels." In all forms of trauma some cells are killed and others are injured, either from the blow or indirectly from interference with their blood supply. The injured area is a favorable place for the growth of bacteria.

Infection may be controlled by the immediate packing of the socket, as phagocytic blood cells within the hematoma or blood clot, and those migrating to the area as the result of inflammation will, in a few hours, destroy all bacteria present. We use a pack made by incorporating absorbent cotton in a mixture of the powder of "Wonder Pack" and a liquid made of equal parts of oil of cloves and mineral oil. This pack does not "set" or get hard. The pack should remain in the socket until granulation tissue has completely covered the walls of the socket. This takes from ten days to two weeks. If the pack is removed or changed before granulation tissue is established, infection results because there are no phagocytic cells to combat the bacterial invasion resulting from the removal of the pack. Necrosis of the soft tissue and the resulting fusospirochetal infection at the mouth of the wound produce the pain experienced in

these slow healing areas. To control this, tannic acid is used to convert the soluble products of protein decomposition into an insoluble protein as in the treatment of burns, described by Davidson.[4]

Anatomic abnormalities, as described by Kronfeld[5] and Thoma[6] are frequently a cause for lack of growth of granulation tissue in wounds within these areas. Kronfeld, in explaining the influence of function upon alveolar bone, says: "Increased function means increased mechanical stimulus and increased activity of the osteogenic cells; consequently, the physiological resorption law will be overcompensated by a surplus of new formation. This increase is called functional hypertrophy. In these functional changes the condition of the alveolar bone remains rather invariable. The supporting bone changes considerably. The greater the functional stress, the stronger and denser will be the supporting bone. In jaws where a number of teeth have been extracted the radiograph will sometimes reveal a thickening and condensation of the bone around the teeth that are still in occlusion." (Functional hypertrophy of the bone.)

Thoma[6] says, "Sclerosing osteitis is produced by low grade or mild infection, with a stimulating action on the osteoblasts, such as often seen in syphilis.

"The marrow spaces and haversian canals become smaller due to apposition of the osteoid material which soon calcifies. Often the bone is so condensed that the fine architecture of the spongiosa cannot be recognized in a roentgen picture. This is spoken of as sclerosis of the bone or eburnation. Circulatory disturbances of the nutrient artery may produce a similar diffuse sclerosis. It generally affects the entire bone, especially if thrombi are formed in the osseous arterials and capillaries.

"Localized sclerosis results from repair in suppurative osteitis, and may be spoken of as scar bone. In other cases low grade odontogenic infection causes condensing osteitis, which can frequently be seen around the roots of infected teeth. In condensing osteitis the bone becomes very radiopaque. This condition may be limited to a definite area, or else may involve a large part of the bone."

In a wound following the removal of a tooth in a region such as described, like the fracture of the neck of the femur, there is a varying amount of necrosis and circulatory damage. Because of exceedingly minimal or even total lacking circulatory status of the area, the source for the growth of granulation tissue and the adequate amount of accessory circulatory supply is such that scant growth of granulation tissue occurs, producing, as in trauma, a so-called "dry socket."

These factors may be anticipated and clinically influenced when the x-ray reveals a sclerosed area around the root of the tooth to be extracted. To influence the interosseous and periosteal vascularity a number of holes are drilled, at different levels, through the periosteum and bone into the socket area. The supporting bone being more vascular than the alveolar bone, holes are also drilled from the socket through the alveolar bone into the supporting bone. In a previous paper we advocated the cutting of a slit of bone from the alveolar margin to the apex of the socket, but the boring of holes seems to be the better procedure. Besides increasing the circulation to the area involved, the chips of bone from the drill supply a source of local calcium.

Carter[7] describes a simple method which he has found effective in the treatment of slow and nonhealing fracture. The procedure consists merely of boring a number of small holes through the fragment ends, across the line of fracture. This gives rise to a certain amount of hemorrhage, allows the penetration of new blood vessels, and furnishes new bone pulp, thus creating a stimulus to new bone formation.

The outstanding factor in the removal of impacted teeth is the large area to be replaced by bone and the excessive trauma of the soft tissues and bone produced in the operation. Trauma followed by massive necrosis acts as a bar to primary healing by destroying the circulatory vessels in and about the wound.

The importance of the control of infection until granulated tissue has grown sufficient to cover the walls of the socket is outstanding. This is best done by increasing lateral circulation by drilling small holes through the periosteum into the socket and the reduction of the blood clot by packing as described.

In all lesions the pH change to the acid side is a factor of importance, as no lesion will heal until the pH returns to normal. Clinical experience indicates that the local acidosis of the tissues involved in the inflammatory process is influenced by the presence of concentrated tri-calcium phosphate in the blood and tissue juices at the site of injury. Such calcium is held locally by a chemical absorption affinity between it and the fibrin of the hematoma and the collagen of the newly formed connective tissue to be deposited in the newly formed connective tissue to form bone.

According to Haldeman and Moore[8] many workers have injected various salts of calcium and phosphorus at the site of experimental fractures in the hope of influencing the rate of healing. Albee and Morrison[9] injected a suspension of tri-calcium phosphate in a gap produced in the radius of a rabbit. The other radius, with the similar defect, served as a control. The average length of time required for union of the fracture treated with calcium phosphate was thirty-one days, as compared with the control, which required an average of forty-two days.

Haldeman and Moore[8] continue as follows: "Cretin[10] found that the injection of the various mineral elements of bone between the ends of experimentally produced fractures resulted in a marked acceleration of the formation of callus and bone. Murray[11] carried out similar investigations in which he filled a gap of 2.5 cm. in a dog's radius with sterile powdered calcium carbonate and calcium phosphate, which was followed by solid bony union. The use of sterile powdered calcium hexose phosphate also proved successful, and union was even more rapid if fibrin from the dog's blood was placed in the gap before adding the calcium salt.

"The experiments of Rollo[12] indicate that the injection of calcium glycerophosphate into the tissues around a fracture in rabbits serves to stimulate the formation of callus and bone.

"A few surgeons have injected various salts of calcium and phosphorus into human beings in the hope of securing an acceleration of bone repair. Murray[13] used powdered calcium triple phosphate and calcium carbonate mixed with blood to fill the defect following saucerization of an infected compound fracture of the tibia. Eden[14] injected secondary sodium phosphate at the site

of the fracture in three instances of delayed healing in human beings. Consolidation resulted in all of the cases, two of which represented fractures of the femur and one a fracture of the tibia. The same author injected calcium glycerophosphate at the site of a bone graft of the femur with good result."

Haldeman and Moore[8] from their experiments, concluded that, "In normal healing under favorable conditions, the continued presence of an excess of calcium and phosphorus at the site of fracture either did not influence the rate of union or retarded it.

"In delayed healing resulting from unknown causes the presence of tricalcium phosphate at the site of the fracture appeared to favor the union.

"In no case did the presence of monocalcium phosphate, dicalcium phosphate or calcium glycerophosphate have a favorable influence."

PYORRHEA

The influence of an irritant in producing continuous necrosis, preventing return of the tissue pH to normal, is the outstanding feature in the production of the pyorrhea lesion. Kronfeld[15] found that in every instance the pocket epithelium was ulcerated and broken up into small islands of epithelial cells. Bone resorption in these lesions is undoubtedly due to or under the influence of a chronic inflammatory process indicated by the ever presence of a polyblastic and plasma cell infiltration. Kronfeld[15] found beneath the ulcerated epithelium a layer of connective tissue showing a varying amount of inflammatory round cell infiltration.

Lacunar erosion (resorption of bone by osteoclasts, resulting in the formation of Howship's lacunae) is always found in these lesions and indicates a slow and progressive pathologic condition. Jaffe[16] in describing lacunar erosion, says: "In certain parts of the normal growing skeleton where there is marked resorption, particularly in the jaw, osteoclasts and Howship's lacunae are present in large numbers, which is also true of certain pathologic conditions in which the resorptive process is slow and progressive" Kronfeld[15] found the main histologic characteristic of resorption in his specimens to be the presence of large irregular osteoclasts lying in Howship's lacunae on the surface of the bone beneath the layer of inflamed tissue.

In clinical experience inflammations are usually caused by bacteria, but they may be produced by any mechanical, physical, or chemical agent capable of producing injury to the tissues. In these lesions it is probably a foreign body irritant that initiates the tissue injury inviting the fusospirochetal invasion (Smith[17]) that is always found in the pyorrhea pocket. Spontaneous healing of these lesions never occurs as it does in the dry socket, osteomyelitis, fractures, and pathologic fracture.

It is probable that the tissue reaction is similar to that described by Chesney,[18] who says: "The essentially destructive character of the late lesions of syphilis, as distinguished from the early lesions, which are not destructive, has been a matter of considerable speculation. Since the spirochetes have been difficult to demonstrate in the late lesions, and therefore have been presumed to be few in number in them, the natural assumption to explain the destructiveness of these lesions has been that the tissue becomes more sensitive to the organism

as time goes on, and finally reaches a stage where it is capable of reacting in a maximum fashion to a minimal stimulus. The name 'Umstimmung' was given by Neisser to this change in the reacting capacity of the tissues; it is obviously another word for 'allergy.'

"One encounters an occasional case in which the early lesions are destructive in character; in these cases the skin lesions consist of large ulcerations with heaped up, oyster-shell-line crusts. Such cases are called malignant syphilis. They are not due to increased virulence of the infecting organisms, but in reality represent a precocious tendency on the part of the tissues of the host to react to syphilitic virus in an exaggerated (allergic) fashion."

This would explain the two forms or divisions of the pyorrhea lesion set forth by modern investigators. Gottlieb's "Schmutzphorrhea" and "diffuse atrophy of the alveolar bone," Box's "simplex" and "complex periodontitis" and Beck's "marginal paradentitis" and "genuine paradentitis."

In the clinical application of these observations it would be necessary to remove the foreign body irritant and the tissue that has become sensitized to the bacteria or their products in order to control the pathologic condition producing the inflammatory reaction. To influence further the return to normal of the tissues involved, we have used tri-calcium phosphate mixed into the blood following operation in the hope not only of supplying local calcium for the rebuilding of bone, but of influencing the tissue pH to return to the normal. We have found primary healing much faster, the "cortical bone closure" hastened, and the after-pain and root sensitiveness much reduced by the use of calcium.

REFERENCES

1. Murray, Clay Ray: Healing of Fractures, Arch. Surg. **29**: 446, 454, 456, 1934.
2. Cameron and Gilmour: The Biochemistry of Medicine, p. 207, Baltimore, 1933, Wm. Wood & Co.
3. Bell, E. T.: A Textbook of Pathology, p. 115, Philadelphia, 1934, Lea & Febiger.
4. Davidson, E. C.: Tannic Acid in the Treatment of Burns, Surg. Gynec. Obst. **41**: 202, 1925.
5. Kronfeld, Rudolf: Histopathology of the Teeth and Their Surrounding Structures, pp. 117-346, Philadelphia, 1933, Lea & Febiger.
6. Thoma, Kurt H.: Clinical Pathology of the Jaws, p. 97, 1934, Charles C. Thomas.
7. Carter, Ralph M.: J. Bone & Joint Surg. **16**: October, 1934.
8. Haldeman, K. O., and Moore, John M.: Influence of Local Excess of Calcium and Phosphorus on the Healing of Fractures, Arch. Surg. **29**: 387, 1934.
9. Albee and Morrison: Quoted by Haldeman and Moore, Ref. 8.
10. Cretin, A.: Quoted by Haldeman and Moore, Ref. 8.
11. Murray, Clay Ray: Repair of Fractures, Minnesota Med. **13**: 137, 1930.
12. Rollo, S.: Quoted by Haldeman and Moore, Ref. 8.
13. Murray, Clay Ray: Delayed and Nonunion Fractures in the Adult, Ann. Surg. **93**: 961, 1931.
14. Eden, R.: Quoted by Haldeman and Moore, Ref. 8.
15. Kronfeld, Rudolf: J. Periodontology **6**: 25, 1935.
16. Jaffe, Henry L.: Resorption of Bone, Arch. Surg. **20**: 372, 1930.
17. Smith, David T.: Fusospirochetal Diseases, p. 69, Baltimore, 1932, Williams & Wilkins Co.
18. Chesney, Alan: Internal Medicine, p. 219, Philadelphia, 1932, Lea & Febiger.

ADAMANTINOMA DEVELOPING FROM ODONTOGENIC CYST

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THE fact that odontogenic cysts are potential adamantinomas has been pointed out by a number of writers. Cahn,[1] Jacobs,[2] and Carpenter and Thoma[3] have reported cases of cysts which on pathologic examination proved to be adamantinomas.

The early adamantine changes may develop in the form of a projection from the surface of the cystic epithelium producing what Cahn has named "mural adamantinoma." Ultimately these mural formations may fill the entire lumen, and a solid monocystic adamantinoma will result.

In other cases the basal layer starts to proliferate, and the adamantinoma develops in the fibrous cystic capsule, and from here grows into the surrounding marrow spaces in which new cysts are formed. Thus a polycystic type of adamantinoma is produced.

The cyst described by Carpenter and Thoma showed very nicely both the papillary projections and the proliferations into the connective tissue, and therefore represents a combination of the two methods of development (see their Fig. 5). The x-ray appearance showed notch formation in the bony wall of the cyst and numerous small accessory cysts which had formed at the periphery of the odontogenic cyst (see their Fig. 2).

The case to be reported shows the mural formations Cahn described, as well as typical adamantinoma forming in the wall of the cyst sac. The surrounding bone, however, was not involved, and there were no typical changes in the x-ray picture, and therefore no indication that the lesion was something more than an ordinary cyst. This tumor represents therefore an earlier stage of development than that reported by Carpenter and Thoma.

Churchill[4] described two dentigerous cysts which assumed adamantinomatous character, but careful microscopic examination showed that the follicles were not completely epithelial in nature. They consisted of epithelial proliferations made up of strands of cells comparable to those seen in the external epithelial layer of the enamel organ. These showed invasive characteristics and formed complete figures around connective tissue stroma, similar to those seen in Fig. 4. Degenerative processes in these connective tissue enclavements tend to obscure further, correct interpretation of such structures. Often, however, blood vessels may be encountered which help to differentiate them from the true follicles. Churchill gave the name pseudo-adamantinoma to such formations in the walls of cysts. He also grouped under this name all those cases which do not show typical follicular epithelial differentiation: ameloblasts, stratum intermedium, and stellate reticulum.

Thoma[5] in his text *Clinical Pathology of the Jaws*, however, recognizes variations of adamantinoma, all having similar clinical features: continual growth, infiltrating character, and recurrence after operation if not completely removed. Although they show great differences in their histologic make-up,

he prefers to describe them as subdivisions of adamantine epithelioma commonly spoken of as adamantinoma, rather than classifying them as separate entities. In all neoplasms the development of the cells and the production of intercellular structures are subject to variation. In some tumors the tissue is developed to the most perfect degree; in others it is arrested at a lower stage, and in many cases cells of all phases of development are found. In addition hereditary influences in the cell may become accentuated and atypical tissue results. The cells of the enamel organ, being derived from ectodermal oral epithelium, have both amelogenetic and adenogenetic potentialities, and therefore in neoplastic development may form both enamel and glandular epithelial structures; thus the adenoid type of adamantinoma is produced. The adamantine epithelioma may present in addition the following histologic variations, according to the degree to which cell differentiation has proceeded.

1. A type of low differentiation seen as chains and strands of epithelium, occasionally forming buds resembling very young, bell-shaped enamel organs. This is the most immature type of adamantinoma, and therefore tends to infiltrate and spread.

2. A type showing formations seen in the early development of the enamel organ. The follicles are lined with a row or two of cells distinctly differentiated from the central cells which are of more stellate form. The follicles are of irregular shape and size, varying from small round or oval formations to sheaths of greater dimensions. Colloid degeneration is frequently found in the central part and microcysts are formed.

3. A type in which the cellular elements have reached a mature stage of development such as is found in the so-called third stage of tooth formation. The peripheral cells have become cylindrical, resembling ameloblasts with the nuclei placed toward the base and often surrounded by a homogenous zone separating them from the stroma. The central cells show decided stellate reticulum formation, and generally there are cells resembling the stratum intermedium. It is the true type of ameloblastoma. Processes of degeneration may be seen in this type also, and in rare instances some of the stellate cells in the center of the follicle take on the form of squamous cells, forming epithelial pearls as in squamous cell or epidermoid carcinoma.

CASE REPORT

Patient, Miss M. S., aged thirty-one years, stenographer, was seen February, 1936, by Dr. Charles M. Proctor for consultation.

Chief Complaint: Swelling on the lower jaw.

History: Family history negative. Patient had had the usual childhood diseases. The present condition was first noticed in September, 1935, at which time the third molar was removed. A swelling had formed which has grown continuously since then.

Examination: Extraorally there is a hard mobile mass approximating the size of a peanut, located on the body of the mandible midway between mental area and the angle of the jaw. Intraorally the mass seems fluctuant, and there is slight crepitation on the buccal portion under digital pressure. The growth extends from the anterior area of the region of the third molar to the distal area of the second premolar, overlaying the upper ridge of the mandible on the buccal side. It is quite red and chronically inflamed due to traumatic occlusion produced by the maxillary second molar which is constantly contracting and irritating the area. There are no symptoms of pain or paresthesia.

X-ray Examination: The x-ray (Fig. 1*A*) shows a cystic area extending from the region of the extracted second mandibular premolar to the third molar region. Below, it borders the mandibular canal and, above, it bulges as high as the occlusal surface of the teeth. The expanded bone here is extremely thin. There are no changes in the outline or the surrounding bone which would indicate tumor formation. The findings are consistent with that of an odontogenic cyst.

Operation: With 2 per cent novocain suprarenin, mandibular method, anterior labial injection in the canine area and buccal injection, a good anesthesia was obtained in twelve minutes. The incision of the mucous membrane was made on top of the ridge from the postmolar triangle to the canine area, carefully dissecting the mucoperiosteal tissue from about the

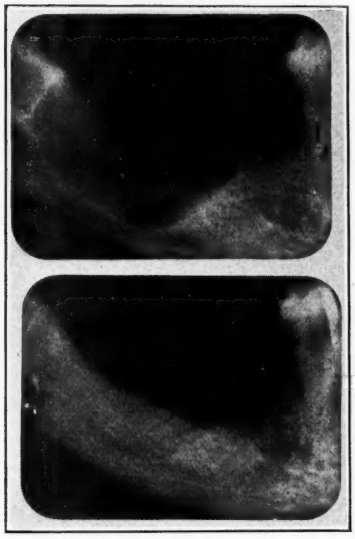


Fig. 1.—*A*, x-ray film showing a cystic area in mandible with expansion of outer surface of the bone; *B*, film of the same mandible five months after operation, showing healing of the bone without recurrence.

Fig. 2.—One-half of the cyst sac showing the mural type of adamantinoma in the wall.

cyst on the buccal side down to the fold of the cheek and on the lingual side 3 cm. from the top of the ridge. Extensive retraction of the buccal tissue disclosed a very thin lamina of bone approximately of eggshell thickness and fluctuant under pressure. This thin layer of bone was removed, and with a blunt dissector the entire mass was enucleated from its attachment to the surrounding walls. It ruptured during the process of enucleation, however, and discharged a thin straw-colored fluid with no cholesterin crystals in evidence. There was slight pain at the posterior point of attachment at the moment of separation, but no hemorrhage. The buccal plate was destroyed down to the cortical layer of the base of the mandible. After the sharp edges of the bone were smoothed with a surgical bur, the cortical lining of the cavity was scarified exposing the spongiosa to facilitate osteogenesis, thus establishing a regeneration of the osseous tissue lost by the encroachment of the growth. The wound was partially closed with four dermal sutures and a dressing was inserted. This was changed

Fig. 3.

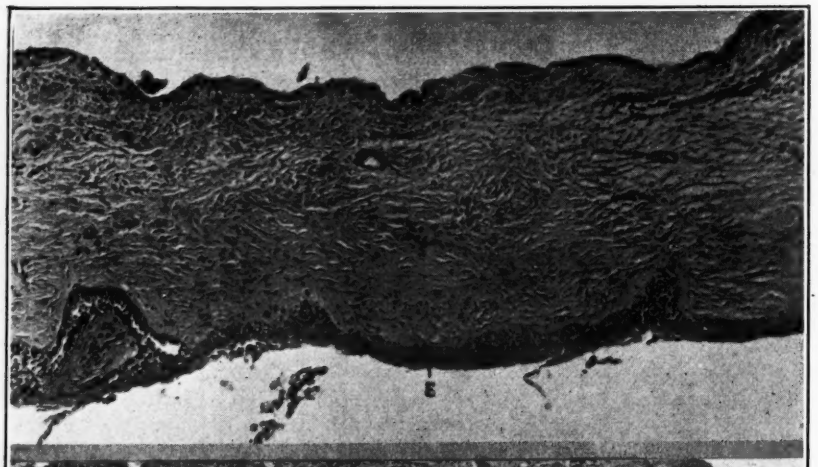


Fig. 4.

Fig. 5.

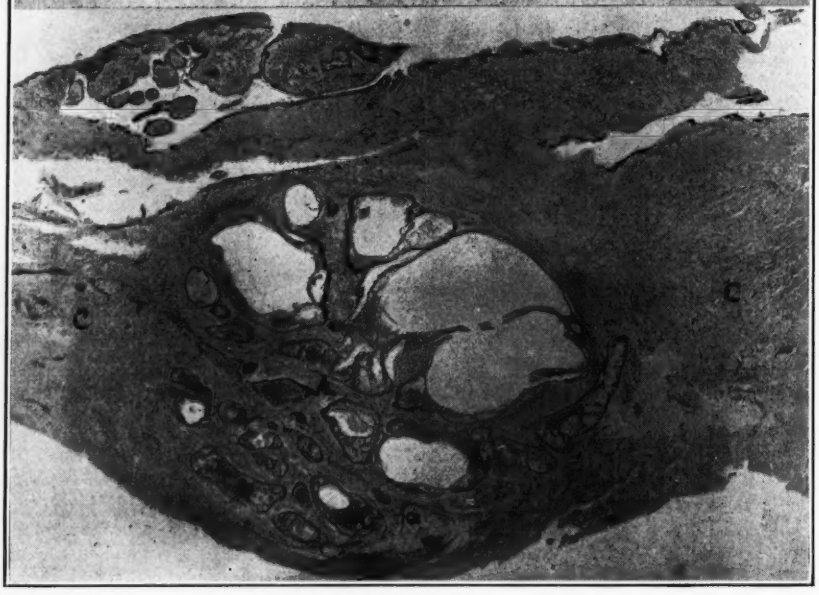


Fig. 3.—Part of the cyst wall; *E*, epithelium.

Fig. 4.—Papillary outgrowth from the cyst wall: *C*, cyst wall; *P*, papillary outgrowth.

Fig. 5.—Cystic wall showing formation of typical microscopic adamantinoma: *C*, cyst wall; *A*, adamantinoma.

several times. After removal of the sutures on the fourth day, the process of healing was uneventful. Five months later the condition was excellent. An x-ray picture showed the entire bone regenerated, and the patient ready for construction of a denture (Fig. 1*B*).

Pathologic Study: The specimen which was first examined by the Leary Laboratory was kindly given for further study to the laboratory of the Department of Oral Pathology, Harvard Dental School, with the diagnosis of adamantinoma.

Gross examination showed a thick-walled empty sac, 2½ × 1¼ × 2 cm., of bulbar shape, which had been incised. The lining showed a pale, partly reddish velvety appearance. There were several areas of nodular projections of mural character (Fig. 2).

Microscopic Examination: The normal part of the cyst sac is composed of a fibrous connective tissue infiltrated with round cells and polymorphonuclear cells indicating inflammation. This is lined by squamous epithelium which at various places shows a heaping up of the basal layer (Fig. 3).

The places corresponding to the mural enlargements seen in the gross examination consist of papillary structures of a complicated make-up. They are lined by chains of basal cell type epithelium which branch and coalesce and enclose loose connective tissue (Fig. 4).

Another nodule was produced by enlargement of the entire cystic wall from the formation of small cystic structures of the enamel organ type (Fig. 5) within it. The epithelial elements here have become further differentiated forming complete and separate circles of elongated cells of a pre-ameloblastic stage but with deeply staining nuclei. The centers of these formations are occupied by stellate cells and cystic areas indicating edema or degeneration. The appearance of these epithelial formations is that of an adamantinoma of low differentiation.

Diagnosis: Membrane of odontogenic cyst giving rise to the formation of adamantinoma.

CONCLUSION

This is another case which proves that the epithelium of an odontogenic cyst, being a derivative of the enamel organ, has the potential power to differentiate into the various types of cells found in the enamel organ, and so form an adamantinoma. We regard any cyst in the wall of which epithelial formations are found that resemble the enamel follicle either in its early or late stage of cell differentiation as a potential adamantinoma. These may not only expand as a monocystic tumor but may also infiltrate neighboring marrow spaces setting up new foci. In the case reported this had not yet taken place, but in the one reported by Carpenter and Thoma,[3] already referred to, new small cysts had been produced around the original odontogenic cyst. The tumor found in these did not differ histologically in composition of its cellular structures from the one reported.

Cysts therefore should be inspected carefully at operation, particularly if a partial extirpation has been planned. If the membrane shows papillary formations or mural thickenings, it should be removed completely. In all cases cyst sacs as soon as removed should be placed in a fixing solution and sent to a pathologist for examination.

REFERENCES

1. Cahn, L. R.: The Dentigerous Cyst as a Potential Adamantinoma, Dental Cosmos **75**: 889, 1933.
2. Jacobs, M. H.: Adamantinoma, Dental Cosmos **77**: 239, 1935.
3. Carpenter, L. S., and Thoma, K. H.: Adamantinoma Formed From a Radicular Cyst, Dental Items of Interest **55**: 716, 1933.
4. Churchill, H. R.: Histological Differentiation Between Certain Dentigerous Cysts and Ameloblastomata, Dental Cosmos **76**: 1173, 1934.
5. Thoma, K. H.: Clinical Pathology of the Jaws, p. 409, Charles C. Thomas, Springfield, Illinois, 1934.

47 Bay State Road

TREATMENT OF ORAL SOFT TISSUE FLAPS AND THEIR DANGERS IN ORAL SURGERY

IRVING GORDON, D.D.S., MIAMI, FLA.

TREATMENT of oral lesions and infections is a very widely discussed subject. Much ink and many words have been used in the publication of the various phases of this broad study, but, strangely, a very important phase has been neglected in modern dental literature.

This article concerns the soft tissue flaps in oral surgery, most especially those flaps of oral soft tissue that surrounds and partially or completely covers the third molar areas. I believe that the care and treatment of these flaps are among the most neglected phases in modern dentistry.

These flaps are most commonly found during the years of eruption of the teeth (particularly the mandibular third molars). If, due to some inhibiting influence, the complete eruption of these teeth is prevented, the flaps may be found present at any time around partially erupted or impacted teeth.

Often they are found around erupting deciduous teeth; and an inflammation of these flaps, due to either an irritation or an infection, resulting in a slight fever and a manifestation of irritability in children, has given rise to the term "teething" so commonly used by the lay public. Any reference here to this condition will refer specifically to *mandibular third molar flaps.*

No doubt every one in his practice has often taken care of a patient presenting the following complaints: extreme discomfort in the posterior part of the mouth around one of the mandibular third molars, usually accompanied by a partial trismus; difficulty in swallowing, which may or may not be present depending upon the extent of the inflammation. A typical remark often made by the patient presenting this complaint is: "Doctor, my gums must be swollen in that area. When I close my mouth, I seem to be biting my gums."

Upon clinical examination the dentist finds a highly inflamed flap of loose tissue covering the distal surface and usually lying unattached on the occlusal surface of the mandibular third molars. The inflammation may be localized in this area or may be quite extensive. The condition is often accompanied by a slight fever and general malaise. A blood picture usually reveals an increased white blood count. Microscopic smears from this area most commonly show a profusion of *Spirocheta vincenti,* but often *Streptococcus pyogenes* and *Streptococcus viridans* are also found. Leptothrix and colon bacilli have been discovered in some few cases, but they are considered to be spectators rather than entering into the actual infection.

The correct term for this condition is pericoronitis—a pericoronal infection—an infection around the crown of a tooth. Entirely too seldom is this

Presented before the Miami Dental Society, December, 1936, Coral Gables, Florida.

term found in the literature, and I believe that too little emphasis is placed upon the importance and dangers of this disease.

An excellent harbor is afforded under these loose flaps of tissue for incubation of the organisms most commonly found in the mouth. Here amid the débris and food particles forced under the flap during mastication, protected from air and light, and in a warm moist environment, the anaerobic organisms flourish under ideal conditions.

The condition begins by the patient feeling an increasing soreness in the mandibular third molar areas, particularly during mastication. As the severity of the infection increases, the patient's physical discomfort and clinical signs increase.

Now an active infection either becomes localized by the body resistance walling it off into an abscess, or will burrow its way toward the point of least resistance to liberate itself. The infection may spread in three ways, and it is here that the greatest danger lies.

First, it may travel along the bone by stripping the periosteum away from the bone in its desire for liberation. This condition usually causes the least amount of trouble, as most often the infection will follow this course to the point of eruption of the tooth and there liberate itself.

Second, by infiltration the infection may travel along the tissue planes of the muscles and thus spread into the deeper surrounding structure. In this way, the direction of the movement of the infection being posterior, the result is a peritonsillar abscess or one of the very common inner ear abscesses. Similarly, conditions of cellulitis and adenitis that are often found accompanying these pericoronal infections may be caused. A number of cases of Ludwig's angina, many of which result in death, have been directly traced back to a pericoronitis for its origin.

Third, by means of the lymphatic channels the infection may find its way into the blood stream and may result in a general septicemia.

In the establishment of the diagnosis of the more serious complications resulting from these infections, only too often is the original cause overlooked or entirely forgotten, and these pericoronal infections do not receive as important a place in our attention as their dangers warrant.

Entirely too often, when patients present this condition, the dentist enacts the following scene: "Why, that is nothing, Mrs. Smith, just a little infection around the crown of that back tooth. With the aid of this electric cautery, we'll have you fixed up in a jiffy—," or— "we'll just trim that flap off a a little and everything will be okay." Then blithely, without aid of microscopic smear or other diagnostic aid at his command, and with little thought of the serious consequences that may result from his act, he proceeds to carry out his threat. The trauma and the injury caused by this surgical interference, in an area in which the local resistance has already been lowered by infection, further lower the resistance and more readily permit invasion of this infection into the deeper surrounding structure.

Treatment of this condition is comparatively simple in the early stages. Establishment of drainage and admittance of the atmospheric air under these

flaps, after the débris has been removed from under them, usually suffice in the removal of the infection before it has become too virulent. The introduction of a specific antiseptic carried in on a drain, in order to maintain the drainage once it has been established, in most cases relieves the condition sufficiently, after a day or two, to permit the operator to perform the surgery with little danger to the patient. If, unfortunately, one of these cases should develop complications, the situation is serious and should be treated as such.

The dentist would escape many sleepless nights and hours of worry if he would abide by the following axiom: "It is a lot easier to *keep out* of trouble than it is to *get out* of trouble."

901 Huntington Building

Department of Orthodontic Abstracts and Reviews

Edited by
Dr. Egon Neustadt, New York City

All communications concerning further information about abstracted material and the acceptance of articles or books for consideration in this department should be addressed to Dr. Egon Neustadt, 133 East Fifty-Eighth Street, New York City.

X-Ray Technic and Interpretation of Dental Roentgenograms. By A. L. Greenfield, D.D.S., 254 pages, 466 illustrations, Dental Items of Interest Publishing Company, 1936, New York City.

In the preface the author states that the purpose of the book is to present to students and practitioners of dentistry the essentials of x-ray physics, x-ray technic, film placing, film processing, pulp testing, and radiographic interpretation in a thorough but concise manner. The author accomplishes this in an able and excellent fashion.

The book opens with a brief and concise chapter on x-ray physics, which includes a discussion of transformers, tubes, properties of x-rays, protection of patients and of operator against the dangers of x-rays, and Grenz rays.

Special considerations in x-ray technic are then discussed, including a description of the special technic necessary in root canal work, overcoming malar bone superposition, etc.

Chapters on intra- and extraoral technic follow. These are profusely illustrated with actual photographs and diagrams. These excellent descriptions, plus the photographs and diagrams, greatly simplify the subject of technic.

Chapter VI covers the subject of placing the films in the mouth. The author states that this subject has been woefully neglected in textbooks and by teaching institutions. This statement is absolutely correct. Proper film placing not only speeds up radiographic examinations but also minimizes gagging. The chapter is illustrated by twenty-three large illustrations, and on account of its importance merits close study.

Processing, mounting, and viewing of films are next discussed. The author stresses the importance of examining all parts of the film. The enamel, dentin, cementum, pulp, peridental membrane, lamina dura, and cancellous bone should be carefully examined for changes from the normal.

Chapters X, XI, and XII cover the subject of "Interpretation." This section comprises the largest part of the book. The great number of illustrations used in these chapters add greatly to the general excellence of the subject matter. The subject of "Interpretation" covers: radiographic appearance of the normal dental tissues; anatomic landmarks; pericementitis; granuloma; alveolar abscess; cysts; osteomyelitis; caries; absorption of the alveolar process; alveolar condensation; resorption of roots; hypercementosis; condensed bone; residual infection; pulp nodules and pulp calcification; secondary dentin; fractures; impacted teeth; retained roots; deposits of calculus in the salivary glands and

ducts; sinus disease; cementoma; exostosis; osteoma; myxoma; odontoma; adamantinoma; generalized osteitis fibrosa; central benign giant cell tumors; Paget's disease sarcoma; carcinoma, etc.

The illustrations throughout the book are excellent and large. Their great number enhance the excellence of the subject matter. The print is good and the quality of the paper is excellent. The index is complete in every detail. The book should receive full commendation.

S. Riesner.

Manual of Dental Roentgenology. By S. S. Wald, D.D.S., 1936, Guggenheim Dental Clinic.

With the manifest interest in radiodontia that is exemplified in the increasing number of books on dental radiography, this new manual comes as a useful and attractive addition.

Although, as the title indicates, it is limited in its scope, it constitutes an excellent manual of technic and promises a strong appeal to the student and beginner, as well as the general practitioner who requires a quick reference to acquaint him with the proper procedure in examining the patient roentgenographically.

Starting with a simple approach to the physics of x-rays, it leads to a concise presentation of the types of dental x-ray tubes and some of the accessories required in taking the picture.

It defines, categorically, all terms encountered in a study of the subject, and explains the action and the function of the accoutrements of dental radiography.

The format is attractive and readily acceptable, being a combination of the mimeograph process in the subject matter, with clearly reproduced photographs that are liberally distributed throughout the book, and which make it almost a book of visual instruction.

S. Riesner.

News and Notes

The American Society of Orthodontists

The annual meeting of the American Society of Orthodontists will be held at the Edgewater Beach Hotel, Chicago, Monday, Tuesday, Wednesday, and Thursday, April 19, 20, 21, and 22, 1937.

Monday will be devoted to sports. Arrangements have been made for a golf tournament and a trap and skeet shooting contest. Bring your shooting irons (mashies and Winchesters) and have a good time. There will be prizes for the winners. In the evening there will be a dinner, after which prizes will be awarded.

The scientific program will begin Tuesday morning. Particular attention has been given to the selection of topics that should be of vital interest to our members and guests and to the qualifications of the speakers. The program not only will deal with the mechanical and practical phases of our daily work but will also cover some of the biologic aspects of the orthodontic problem. There will be a sufficient number of case reports presented by men of experience.

The Clinic Committee has assembled a large number of excellent clinics which will occupy the entire Tuesday evening session.

Wednesday will be another full day of essays and case reports, with a business session in the afternoon.

The banquet, which is always a splendid affair, will be held Wednesday evening. There will be music and dancing and also an added feature of genuine significance, the conferring of the first annual Albert H. Ketcham Award.

Thursday morning will be devoted to essays and case reports, and during the afternoon there will be six lecture clinics by men of outstanding ability, followed by a short business session.

The Scientific Exhibits Committee announces that there will be a large and varied exhibit of interesting and educational material. There will also be a hobby exhibit; so please bring or send us an exhibit for this new feature. We feel that many of our members are in a position to help make this new departure a real success. A large number of dealers' exhibits have been secured, and you will be able to look over all the new materials and gadgets.

Last but not least, the Ladies' Entertainment Committee will be prepared to see that the ladies have an enjoyable time. The hotel management has quoted a very moderate rate for our members. We shall be looking for you.

PAUL G. SPENCER, President.

American Board of Orthodontia

A meeting of the American Board of Orthodontia will be held at the Edgewater Beach Hotel, Chicago, April 17, 1937. Orthodontists who desire to qualify for certificates from the Board should secure the necessary application blank from the secretary. The application must be returned to the secretary, together with any other required credentials, at least sixty days prior to the date of examination. Applications filed at the time of the Board meeting will have

preliminary consideration, so that the applicant may be advised of the work required for his subsequent examination. Attention is called to the following resolutions adopted by the Board:

Any person desiring to make application to the Board for a certificate must have been in the exclusive practice of orthodontia for a period of not less than five years or an equivalent to be determined by the Board and based upon the following conditions:

1. He must be an instructor in orthodontia in a school satisfactory to the Board.

2. He must be an associate in the office of an orthodontist whose standing is satisfactory to the Board.

3. It is definitely to be understood that any person at the time of making application for a certificate shall be in the exclusive practice of orthodontia in his own name.

CHARLES R. BAKER, Secretary,
636 Church Street,
Evanston, Ill.

Cleveland Dental Society

The sixth annual two-day clinic meeting will be held May 3 and 4.

CARLYLE MUEHLHAUSER, General Chairman,
8812 Lorain Avenue
Cleveland, Ohio.

European Orthodontological Society

The next meeting of the European Orthodontological Society will be held in Brussels on May 17 and 18, 1937, under the presidency of Dr. Lucien De Coster. The Headquarters will be at the Palace Hotel. The scientific meetings will be held in the new Eastman Clinic buildings, by courtesy of Dr. Watry.

Communications from those who desire to contribute to the program may be addressed to

G. F. CALE-MATTHEWS, Hon. Secretary
95, Newhall Street
Birmingham, 3, England

American Dental Assistants Association

The Thirteenth Annual Meeting of the American Dental Assistants Association will be held at Atlantic City, New Jersey, July 12-16. For further information address:

LUCILE S. HODGE, General Secretary,
401 Medical Arts Building,
Knoxville, Tenn.

Pacific Coast Society Meeting

The seventeenth general meeting of the Pacific Coast Society of Orthodontists was held on February 22 through 25, 1937, at the Palace Hotel in San Francisco, California, with president John E. Taylor, of Hollywood, California, in the chair. The program was dedicated to two of the society's honored members: Dr. B. Frank Gray and Dr. James D. McCoy. The banquet was held in honor of Dr. Frank M. Casto, past president of the American Dental Association, who was both guest of honor and speaker.

The program consisted of the following:

Monday, February 22

Welcome—Arthur R. McDowell, D.D.S., San Francisco.

President's Address—John E. Taylor, D.D.S., Hollywood, California.

Charge to New Members—James David McCoy, D.D.S., Los Angeles, California.

Endocrinology and Its Relation to Orthodontics—Herman Becks, M.D., D.D.S., University of California.

The Application of the Principles of the Edgewise Arch in the Treatment of Class II, Division I Malocclusions—Charles Tweed, D.D.S., Phoenix, Arizona.

Nutrition—One Factor in Orthodontics—Nina Simmonds, Sc.D., University of California.

Discussion—E. F. Lussier, D.D.S., San Francisco, California.

Banquet—Frank M. Casto, D.D.S., honored guest and speaker (arrangements in charge of J. Kester Diment, D.D.S.).

Tuesday, February 23

The Factors that Produce Orthodontic Conditions in Children as Viewed from a Pediatric Standpoint—William Palmer Lucas, M.D., San Francisco.

Orthodontics Under the Crippled Children's Act—Will G. Sheffer, D.D.S., San Jose, California.

Discussion—Charles L. Ianne, M.D., Director of the Division of Tuberculosis, Santa Clara County.

Mandibular Changes in Orthodontic Treatment—James David McCoy, D.D.S., Los Angeles, California.

Round Table Luncheon—

Diet—Charles Mann, D.D.S., Seattle, Washington.

Root Resorption—W. J. Lea, D.D.S., Vancouver, B. C.

Growth in the Dental Mechanism During Orthodontic Treatment—Robert Dunn, D.D.S., San Francisco, California.

Impacted Cuspids—Allen Scott, D.D.S., San Francisco, California.

Chromium Alloy—Dallas McCauley, D.D.S., Los Angeles, California.

Endocrinology—Frank Heimlich, D.D.S., Santa Barbara, California.

Anatomy and Mechanical Principles in Diagnosis and Treatment of Malocclusion—Spencer R. Atkinson, D.D.S., M.D., Sc.

Discussion—Herman Becks, M.D., D.D.S., University of California.

Case Report—William Dinham, D.D.S., Seattle, Washington.

Some Inherent Factors in the Growth of the Skull—John B. de C. M. Saunders, F.R.C.S., Associate Professor of Anatomy, University of California.

Wednesday, February 24

Centric Occlusion—Frank A. Williams, D.D.S., Pasadena, California.

Factors Which Determine the Esthetic and Functional Positions of the Teeth—David McLean, D.D.S., Los Angeles, California.

Case Report—M. R. Chipman, D.D.S., Spokane, Washington.

Business Meeting—Report on President's Address—

Clinics were given by:

Frank A. Williams, D.D.S., Pasadena, California.
David L. England, D.D.S., Santa Barbara, California.
David W. McLean, D.D.S., Los Angeles, California.
A. Frank Heimlich, D.D.S., Santa Barbara, California.
Dallas R. McCauley, D.D.S., Los Angeles, California.
Thomas R. Sweet, D.D.S., Oakland, California.
L. R. Sattler, D.D.S., Los Angeles, California.
Will G. Sheffer, D.D.S., San Jose, California.
H. V. Muchnic, D.D.S., Los Angeles, California.
George L. Turner, D.D.S., Los Angeles, California.
Aldys J. Gray, D.D.S., Los Angeles, California.
Wilbur E. Bedford, D.D.S., San Bernardino, California.
Hays N. Nance, D.D.S., Los Angeles, California.

Thursday, February 25

The Anatomic Basis of Diagnosis and Treatment—Demonstration by means of models, model sections, masks and photographs, to show anatomic derangements associated with malocclusions and their use as aids to diagnosis. Demonstration by means of maxillary and mandibular bone sections, to show the distribution of cortical and cancellous bone, in relation to types of anchorage and the possibilities and limitations of orthodontic treatment.

Practical Applications of Chrome Alloy in Orthodontics—Types of appliances and attachments used, featuring Universal brackets. Band construction; band and attachment assembly. Application of appliances in full arch and segment designs. Completed cases.

The Southern California Orthodontic Study Group. Director, Spencer R. Atkinson, D.D.S., M.D. Sc.

Clinicians—Doctors Aldys Gray, Fred E. McIntosh, Ben L. Reese, John E. Taylor, Walter J. Furie, E. M. Johnson.

Eastern Association of Graduates of the Angle School of Orthodontia

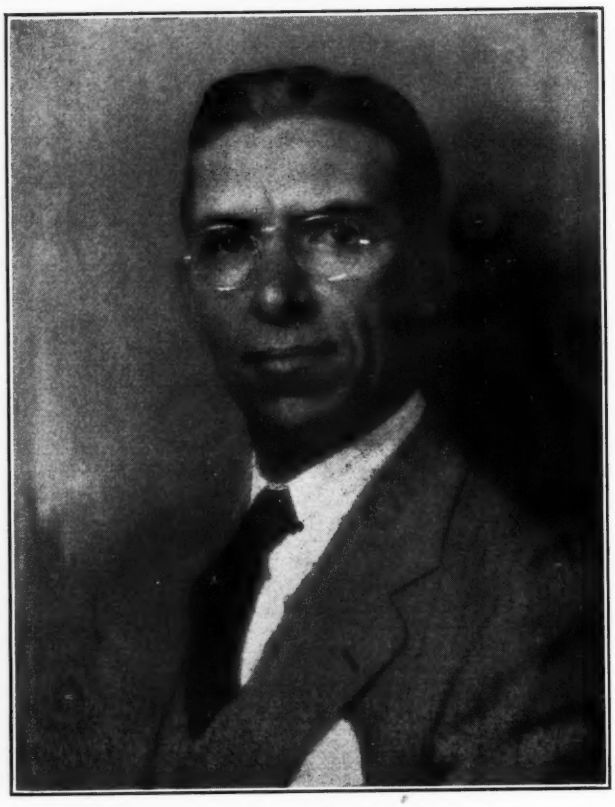
The Eastern Association of Graduates of the Angle School of Orthodontia will hold its annual meeting at Cleveland in the Laboratory of Anatomy of Western Reserve University on Monday and Tuesday, March 15 and 16, 1937.

This two-day program will be furnished by Doctor T. Wingate Todd and the staff of the Brush, Bolton and Associated Foundations.

Doctor Todd's presentation will open each day's session. On Monday he will speak on "The Constitution of the Normal Child" and on Tuesday "The Mineralization Problem in Orthodontia," which indicate the general theme of the papers and x-ray exhibits that follow, to be given by Doctors Anderson, Broadbent, Cohen, Francis, Krogman and Zuck. The practical application of the Bolton standards of normal facial development and the results of eight years' use of the standardized x-ray technique in routine office practice will be discussed in detail.

Time has been arranged for the study of exhibits from the scientific records of the Foundations and the inspection of the Laboratory of Anatomy which houses an outstanding collection of human and anthropoid skeletal material in its widely known Hamann Museum.

The Association's headquarters will be in the nearby Wade Park Manor where special rates have been secured for members and guests. Guests will be most welcome and can be accommodated up to the capacity of the Laboratory provided notifications are received promptly.—*The Executive Committee.*



DR. P. G. SPENCER

President of the American Society of Orthodontists
1936-1937